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IMPERIAL COMMUNICATIONS.

WE recently commented on an interview between a deputation from the Empire Press Union and the Postmaster-General, Mr. Neville Chamberlain, with regard to the delay in establishing a system of wireless telegraphic communication between the Home country and the Dominions; since then the question has gained in prominence and urgency. In *The Times* of January 16th the Cape Town correspondent of that journal stated that grave doubts were entertained in South Africa about the British wireless policy, and that it was feared that the British Post Office was "still allowing itself to be spellbound by the malign influences which have worked such havoc in the past." The correspondent, with brutal candour, states that the South African Government has contracted with the Marconi Company for the immediate erection of a transmitting station there, and that a British station of equivalent rating, capable of maintaining duplex communication with the former, is essential; but whether this station be erected by a private company or by the State is a matter of indifference to South Africa (though a passing sneer is levelled at the British official record in wireless). He further foreshadows a storm of protest in South Africa if the British Government pronounces in favour of a low-power station in this country—a station of high power is indispensable for communication with South Africa and Australia.

This vigorous communication was endorsed in *The Times* of January 18th by Sir Joseph Cook, High Commissioner for Australia, who stated that his Government in March last year concluded an agreement with an Australian wireless company for direct services between Australia and Great Britain and between Australia and Canada; the general manager had been in London during the past six months in connection with this scheme. The Australian Government merely sought the permission of the British authorities to erect a high-power station in this country, and would carry out the work for itself, a million sterling having already been subscribed for this purpose.

India, also, impatiently awaits a decision on the part of the British Post Office. India never approved of the proposal to make Egypt a half-way house in the wireless chain to the East; she seeks direct communication with England, and takes her stand alongside of the Dominions on that ground. The Indian Government does not propose to build a station at its own cost; it would entrust the work to private enterprise, and leave the operation of the system also to the latter.

Canada does not figure amongst the references that we have quoted, but it is well known that the Dominion has already adopted the same policy.

Lastly, the Federation of British Industries has entered the field, a special committee of the Federation set up to deal with this subject having resolved that "This committee urge H.M. Government immediately to grant facilities for the rapid development of long-distance wireless communication and are strongly of opinion that this would be best accomplished by means of private enterprise."

It will be seen, then, that there is a consensus of opinion, in accordance with that which we uttered a fortnight ago—that the establishment of wireless communication with the rest of the Empire is a matter of urgency, and that it could quickly be accomplished if entrusted to the hands of private enterprise.

The Federation, in forwarding to us a copy of the resolution, points out that two years ago the then Government decided that the Post Office should carry out the erection and operation of the Imperial stations in this country, but that licences should be granted to private firms for stations communicating with countries outside the Empire; nevertheless, the Post Office has rejected repeated applications for licences on the part of wireless telegraph companies. The decision with regard to the Imperial chain was conditional upon the agreement of the Dominion Governments and upon the ability of the Post Office to conduct the business efficiently without recourse to privately-owned patents; but obviously the Dominions have withheld their consent, and, on the other hand, the Post Office scheme contemplates the erection of only one station for communication with the whole of the Empire—and that of comparatively low power, an absurd proposal. Financial considerations are wholly in favour of private enterprise, which is prepared to defray the whole cost, thus relieving the Exchequer of a very heavy burden at a time when State expenditure must be restricted to the minimum. The Federation also, very rightly, lays stress on the importance of research, and points out that if the wireless industry is not granted licences for long-distance communication it will be unable to submit the products of its researches to practical tests in this country, and therefore will be driven overseas.

It appears to us that the Government's policy of procrastination is not only utterly inexcusable, but also is highly detrimental to the interests of this country. Whether the Post Office Department or the late Cabinet is the guilty party we do not know. But it is quite certain that if the new Government does not speedily rectify the position and adopt a vigorous progressive policy, it will be blameworthy in the highest degree. Further delay would be disastrous.

Thermionic Currents.

The importance of research and its immense, unbounded possibilities are again demonstrated by the results obtained at the Schenectady Laboratories of the General Electric Co. (U.S.A.), of which we give particulars elsewhere in this issue. It will be noted that by what we may call a slight adulteration of the pure tungsten filament with thorium oxide, the electron emission is increased 130,000 times. What this portends can hardly be realised at the moment; apart from its profound significance from a purely physical point of view, it has many immediate practical applications. For instance, it opens the way to great strides forward in the development of thermionic rectifiers, and thus has an important bearing on electric railway traction. Again, it should help to solve the problem of direct-current transmission at very high pressures, and possibly, with the aid of the high-vacuum tube known as the "Magnetron," which is now being developed to deal with 1,000 kilowatts, the difficulty of converting the direct current back to alternating current and thus simplifying its utilisation at the receiving station will be overcome, so that we may generate alternating current, transmit by direct current at 100,000 volts or more, and distribute alternating current—an ideally economical and elastic system. Another obvious application is to the triode valve, which has already become a familiar feature of the home and, originally developed for warlike uses, has added to the joys of countless firesides. We suggest that these successive advances which we owe so largely to the Schenectady Research Laboratories foreshadow vast changes in the practice of electrical engineering on the largest scale, whilst they will also exercise great influence upon many other branches of the industry; and once more we wish to emphasise most forcibly the supreme importance of research—not merely what is called "industrial research," for which our Scientific and Industrial Research Department shows a marked preference, but research in pure physical science; the industrial applications will soon follow, but the physicist must lead the way and open the gates. There is no end to the hidden mysteries of Nature, which science by slow and patient steps continually reveals—the farther we go, the richer seem her stores.

The Human Side of Industry.

We believe that all sections of the industrial community derive satisfaction from the fact that the Duke of York has taken a practical interest in the subject of industrial welfare. In his speech at the festival dinner of the Industrial Welfare Society on Thursday of last week he referred to the growing conviction that industry must be dealt with in a new spirit and with a new purpose if some of our present national difficulties were to be solved. We do well to dwell upon these words "new spirit" and "new purpose" when, owing to the present conditions of industry and trade, men are ready to suspect that reactionary tendencies are at work which will obstruct anything suggestive of betterment. The Duke is young, and he should be privileged in the years that lie ahead of him to witness substantial alterations in the direction of humanisation of industry, the pursuit of high ideals and the realisation of happiness and contentment.

Earlier in the day his Royal Highness had visited the works of the London Electric Wire Co. at Walthamstow, and on other occasions he has visited various factories, workshops, and mines. It was as the result of close attention to the subject that he was able to congratulate the Society on the commonsense practical work which it was doing to create and foster a spirit of comradeship and loyalty, keeping always in the foreground the claims of the human side of the industry. So far as the needs of the Society are concerned, one of the most pressing, according to the Director, Mr. R. R. Hyde, is a training centre where men and women temperamentally suited for the task of welfare supervision may receive instruction in the technical details with which they will have to deal. The success or failure of welfare work depends very largely upon those who try to carry it out and their ability to retain the full co-operation and goodwill of all connected with a works administration.

The Alliance Appeals for £100,000.

The National Alliance of Employers and Employed, which has been at work for some years endeavouring to encourage in practical ways the spread of a spirit of co-operation in industry, has issued an appeal for £100,000 to ensure the continuance and expansion of its work. The "Alliance" has been established between over two thousand "national and local trade unions on the one side, and on the other such national associations of employers as the Federation of British Industries, of merchants and traders such as the Association of British Chambers of Commerce," also the Central Landowners and others. In a *Times* letter signed by leading authorities connected with the movement it is stated that the organisation has established 35 joint committees of employers and delegates of trade unions in industrial areas, and that through their agency "not only have a number of actual disputes been terminated, but many others prevented by restoring goodwill on both sides." The letter goes into further details regarding valuable work that has been and is being done, and the Alliance claims to be able to point to actual achievements over a period sufficiently long to justify the belief that it has found the true path to industrial conciliation. It is therefore felt that the time has come when its activities, hitherto restricted by the capacity of its members to find funds, should be extended to cover the whole country.

Work of such a kind cannot possibly be carried on without funds—hence the appeal, to which we unhesitatingly give our support.

When we began to read the letter in *The Times* we were expecting to find some announcement therein showing that the movement to amalgamate the Alliance with

the Industrial League and Council had been successful. But unhappily that matter was left severely alone. When we turned to the *Financial Times* of the same day, however (Saturday, January 20th), this paragraph met our eye:—"*Industrial Fusion Rejected.*" "Final endeavours to amalgamate the National Alliance of Employers and Employed with the Industrial League and Council have proved abortive. Difference in the constitution of the two organisations is stated to be the point of difficulty." Well! Well!! What a discreditable abortion. We sometimes imagine differences of constitution as a barrier between an employer and an employé, yet nevertheless, as associations, we try to bring them together in order that they may recognise that they have a common interest. Do these Associations love one another so little that they cannot conceive of some way of composing their differences? Both organisations are needing financial support, so we ought really to be told exactly what these constitutional differences are. It may be that one has a preference for talk while the other believes more profoundly in work—we do not know. It may be that we are entirely wrong, but, until we do know more, our inclination will be to back the Alliance, for its appeal conveys an idea of a definite programme of hard work for hastening peace in industry as a basis of mutual prosperity. Heaven knows that there is room for somebody to carry on the good work when we read that "during 1921 and 1922 no less than 105,900,000 days were lost through industrial strife."

Public Contracts and Unemployment.

We desire to draw attention to the very timely letter on this subject that has been addressed to the Prime Minister by the Federation of British Industries. With unemployment so prevalent in all parts of the United Kingdom, it is inconceivable that those who are responsible for our national and local government should allow contracts to pass by British manufacturers, save under the most exceptional circumstances. We trust that the letter, a copy of which appears in our "Business Notices" to-day, will influence the Government in forming a stimulative policy for British industries, and we fervently hope that the publicity that the action of the F.B.I. gives to the subject will influence councillors and others who have it in their power to assist their fellow-Britishers to secure productive work.

The I.E.E. Membership.

At the meeting of the Institution of Electrical Engineers last Thursday the balloting list contained the names of 369 candidates for election, in addition to some 80 candidates for transfer to higher grades. An earlier list of the current session had contained 130 names, and in all the membership is now about 10,800; before the close of the session the eleventh thousand may be passed. It is interesting to observe that in the grades above that of Student, roughly one-third of the candidates have addresses overseas, mainly in the British Empire, but not a few in foreign lands. One woman Graduate was elected.

The majority of the new members are Students; but that is quite in order—in a few years most of them will be found in higher ranks, and the fact that electrical students now regard it as the normal course to join the Institution is a good sign. They are most desirable additions to the membership, which is thus fed with a constant stream of technically trained young men, who will in time attain the rank of engineers.

The popularity of the Institution, which has steadily grown since the war, is due to the fact that, more than any other body except, perhaps, the Junior Institution of Engineers, it has cultivated in recent years the seed sown by Dr. Ferranti in 1910. It has adopted the "broader view" of its functions and duties, and has had regard for the human needs of individual members, without neglecting its scientific aims; and realising that science and industry are inseparable and mutually dependent, it has admitted industrial and administrative subjects to its programme of papers and discussions. Thus it has made itself the great representative body of the electrical engineering community as a whole, and has acquired a reputation for vitality and enlightenment second to that of no other engineering institution. So long as it pursues that path of progress, its prosperity is assured.

Plant Contracts.

Among the contracts that have been placed during the last week or two there are several that possess particular interest beyond the fact that they involve substantial expenditure producing employment in British electrical and engineering workshops. For example, the placing of an order for a new 15,000-kW turbo-alternator for Lots Road power station (costing £53,000 without the condensing plant) to supply energy for running the underground railway extensions which are now in hand, is accompanied by the decision to effect improvements in the electrical plant already in service at that station to the tune of £47,600. One of the improvements is the replacing of the cast-iron cylinders of the existing turbines with cylinders of steel in order to increase the reliability of the plant.

The placing of an order for a 40,000-kW turbo-alternator to be built at Newcastle-on-Tyne for the Commonwealth Edison Company of Chicago, while it provides an acceptable tribute to British electrical engineering design and production, is also another feather in the cap of Messrs. Parsons, and is a testimony to the readiness of our American *confrères* to profit from the latest steam turbine experience available in this country.

The Registration of Contractors.

Some time ago the Council of the Institution of Electrical Engineers appointed a Committee to deal with the question of compulsory registration of electrical contractors, but the strong opposition that was experienced led to the abandonment of the proposal. However, a voluntary registration scheme was substituted, and has now been approved by the Committee. As announced in our "Notes" columns, a Registration Authority representative of all branches of the industry is in course of formation. The registration of contractors has been adopted in Australia and South Africa, and in this country the contractors some years ago endeavoured to induce the Board of Trade to institute a measure of this kind, without success. It may be taken, therefore, that the contractors as a body desire registration, with a view to putting an end to the existing conditions, which permit even the most incompetent of wiremen to style themselves "electrical engineers and contractors," and to follow the usual disastrous course—reckless underestimating, scamped work with shoddy materials, and ultimate bankruptcy.

Commercial Arbitration.

The Court of Arbitration which has been organised by the International Chamber of Commerce for the settlement of international commercial disputes, and to which we have referred here in detail already, was inaugurated at Paris on Friday afternoon last. The inaugural address was delivered by M. E. Clémentel, the first president of the New Court. One of the principal speeches was that of Sir A. J. Hobson, president of the British Committee, in which he reviewed the progress of commercial arbitration in England and in other countries, and dwelt upon the advantages of arbitration in disputes between parties of different nationalities. Business firms in fifteen countries are concerned in the scheme now inaugurated. The Paris scheme is designed to assist the world movement, and it was stated by Sir A. J. Hobson that the League of Nations was interested in the subject and would shortly call upon its members to pass legislation recognising the arbitration clause in contracts.

BACK-TO-BACK TESTS OF CONTINUOUS-CURRENT MACHINES.

By C. F. SMITH, D.Sc., M.I.E.E.

SEVERAL points in connection with the back-to-back methods of testing machines (Hopkinson tests) are well-known to engineers who are in the habit of conducting such tests, but are not generally dealt with in the printed accounts of these methods of testing.

In particular, the estimation of the efficiency of the machines from the results of the tests is a matter which is inadequately treated in most text-books.

Calculation of Efficiency from Back-to-back Test.

The losses observed in the test are the losses in two machines which are operating respectively as generator and motor.

Unless the two machines operate at the same current and voltage,* it would be wrong to assume that the losses in them are equal and that half the total loss occurs in each machine. The loading of the two machines during the test is, however, not very different in magnitude, and we might fairly assume that, if they both worked at the *average* value of voltage and current observed in the test, they would experience equal losses. These losses would be the average value of those actually measured, *i.e.*, one-half the total loss for each machine.

Thus, if 2w = total power supplied during test,

I_g, I_m = armature current of the generator and motor,

E_g, E_m = armature voltage,

we should be almost correct in assuming that w would represent the losses in either machine when working at an armature current of

$$\frac{I_g + I_m}{2} \text{ and a voltage of } \frac{E_g + E_m}{2}.$$

From the observations of the test, we may accordingly plot a curve representing the losses in one machine on a base of armature current; in this curve w (*i.e.*, half the total measured losses) would be plotted vertically and corresponding values of $\frac{1}{2}(I_g + I_m)$ horizontally.

The shunt-winding losses are usually kept separate in carrying out the test. These losses may now conveniently be added to the curve of w. Calling the normal shunt losses of one machine W_f, we have then the values of the total losses per machine for any given armature current, *viz.*, $W + W_f$.

If the voltages of the machines are not equal in the test (*e.g.*, as in Method IV, given later), the mean of the two voltages must be used in the calculation of efficiency based on the losses determined in the manner just described.

The next step in the calculation of efficiency depends upon whether the efficiency required is for the machine acting as a generator or a motor.

If I, E are the armature current and voltage, and $W + W_f$ is the loss, as plotted for one machine, we have —For a motor:

$$\text{Efficiency} = \frac{\text{output}}{\text{input}} = \frac{I E - W}{I E + W_f} \times 100 \text{ per cent.}$$

For a generator:

$$\text{Efficiency} = \frac{\text{output}}{\text{input}} = \frac{I E}{I E + (W + W_f)} \times 100 \text{ per cent.}$$

Example.—In a test carried out according to Method III, given below, the generator output was 100 volts, 82 amperes, while the motor input was 100 volts, 118 amperes. In addition, the normal field current for two machines was 4 amperes at 100 volts. Thus, the total losses for one machine amounted to

$$\tfrac{1}{2}(100 \times 118 - 100 \times 82 + 4 \times 100) = 2{,}000 \text{ W},$$

at an armature current of $\frac{1}{2}(118 + 82) = 100$ A.

The efficiency of one machine working as a generator giving an output of 100 volts, 100 amperes, or 10 kW, would be—

$$\frac{\text{output}}{\text{input}} = \frac{100 \times 100}{100 \times 100 + 2{,}000} = 83{\cdot}5 \text{ per cent.}$$

As a motor working with the same armature current, the machine would have an efficiency of—

$$\frac{\text{output}}{\text{input}} = \frac{100 \times 100 - 1{,}800}{100 \times 100 + 200} = \frac{8{,}200}{10{,}200} = 80{\cdot}3 \text{ per cent.}$$

and an output of 8 kW, or 13.4 b.h.p.

One or two notes may be added to the discussion just given. The losses observed in the test should not strictly be taken to apply to the *mean value* of the armature current, as suggested above, but to a value slightly greater than this. For a given voltage and speed we may assume that the losses consist of two parts, *viz.*:—

(i) Fixed losses, due to shunt excitation, friction, windage, and no-load iron loss, and

(ii) Variable losses (due mainly to resistance of the armature and series windings), which vary in proportion to the square of the armature current.

For one machine (either generator or motor), we may express the losses as—

$$W = a + b I^2 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where W = total losses in the machine,
I = its armature current,
a, b are constants.

Assuming the machines to be identical in construction, we may write the total losses measured in the test as follows, where the suffixes g and m serve to indicate the machines which operate respectively as generator and motor in the test.

$$\text{Total loss} = W_g \times W_m = a + b I_g^2 + a + b I_m^2$$
$$= 2a + b(I_g^2 \times I_m^2) \quad \ldots \quad \ldots \quad (2)$$

$$\therefore \tfrac{1}{2} \text{ total loss} = \frac{W_g + W_m}{2} = a + b\left(\frac{I_g^2 + I_m^2}{2}\right) \quad (3)$$

Comparing this result with (1) above, we see that half the total loss is equal to the loss which would occur in either machine at the same speed and voltage when carrying an armature current of

$$\sqrt{\frac{I_g^2 + I_m^2}{2}} \text{ amperes.}$$

This current is the "root-of-mean-squares" value of the two currents observed in the test, and not the mean value, as suggested for simplicity in the general discussion above.

A slightly different method of calculating the efficiency of a single machine may be employed when the resistances of the various windings are known.

Let R_g, R_m be the total resistance of the armature circuit (including series field windings) for the generator and motor. Then, employing other symbols as before,

Total copper loss during test $= I_g^2 R_g + I_m^2 R_m$.

This quantity can be calculated and subtracted from the total losses measured, so as to give the iron and friction losses of the two machines, thus:—

Iron and friction losses from one machine

$$= W - \tfrac{1}{2}(I_g^2 R_g + I_m^2 R_m) = W_o \text{ (say).}$$

From this value and the known resistances, it is now a simple matter to calculate the efficiency of the machine when working at any armature current.

Efficiency with armature current I is—

For a generator (separately excited):

$$\frac{\text{output}}{\text{input}} = \frac{I E}{I E + W_o + I^2 R + W_f}.$$

For a motor:

$$\frac{\text{output}}{\text{input}} = \frac{I E - W_o - I^2 R}{I E + W_f}.$$

* They do in Method I, given later.

The methods of calculation given above are much to be preferred to the one according to which the efficiency of one machine is taken to be the square-root of the joint efficiency of the two under test. Briefly, the principle of the latter is as follows:—

The overall efficiency of the two machines employed together in the test is evidently

$$\frac{\text{output}}{\text{input}} = \frac{\text{watts given out by generator}}{\text{watts supplied to motor}}.$$

If both machines were working at the same efficiency and were equally loaded, it would be correct to regard the overall efficiency as made up of the product of the separate efficiencies of the two machines, so that—

$\eta_{12} = \eta_1 \times \eta_2$; or, since the efficiencies of the machines are equal,

$\eta_1 = \eta_2 = \sqrt{\eta_{12}}$;

where η_1, η_2 are the efficiencies of the two machines, η_{12} is the overall efficiency of the two together.

That is, we should obtain the efficiency of either machine singly by taking the square-root of the efficiency of the set as obtained in the test.

This is the method often adopted. Also, since the loading of the machines is not equal, it is usual to take the efficiency thus calculated to apply to a loading which is the mean of the input and output of the set.

Example.—Employing the same figures as in the previous example, generator output, 100 volts, 80 amperes, and motor input 100 volts, 120 amperes.

The overall efficiency of the two machines is evidently

$$\frac{\text{output}}{\text{input}} = \frac{100 \times 80}{100 \times 120} = 66{\cdot}7 \text{ per cent.}$$

According to the assumption just made, we should obtain as the efficiency of either machine the value $\sqrt{.667} = .816 = 81.6$ per cent at a load of

$$\frac{80 \times 120}{2} = 100 \text{ amperes.}$$

The assumption of equal efficiencies of the two machines is not in accordance with the facts, since the machines are not equally loaded and have unequal losses. Further, the term "efficiency" applied to a machine, without discriminating between its operation as generator or motor, leads to serious confusion, since it is impossible to say to what output this efficiency applies.

Another aspect of these tests which is not adequately appreciated is the connection existing between the various alternative methods of supplying the losses. It should be fully realised that there is no single arrangement which is the best for all purposes, but that the object of the test in any particular case should determine the connections employed.

Purposes of Back-to-Back Test.

A back-to-back load test may be carried out for any, or all, of the following purposes:—

1. To ascertain the temperature rise after a run of certain duration at full load (heat run).
2. To determine the regulation of a generator under load (regulation test).
3. To measure the efficiency of the machine under load (efficiency test).

The order in which these items are given indicates their relative importance from a practical point of view on the test-bed of a works. The objects of the load test are specially enumerated here, because the arrangement chosen for the test should be determined by the purpose which is regarded as the most important in any particular case.

Method 1.—*Mechanical Drive and Auxiliary Booster.*—This is the most complete form of test, and is indicated by the diagram fig. 1. Two similar machines are electrically coupled in opposition, and are also coupled mechanically and driven by an auxiliary motor, which overcomes the iron and frictional losses of the set. The machines are driven at their normal speed and excitation.

If there is no voltage in the armature of the booster B, the voltages of the machines M and G would be in mutual opposition, and no current would flow in the armature circuit. If the voltage of B is gradually raised by regulation of the booster field, a current will flow, and can be adjusted to any desired value. The value of this current will be—

$$I = E_B (R_M - R_G)$$

where E_B = voltage at booster terminals.

R_M, R_G = resistance of the armatures of machines M and G.

Evidently the power given out by the booster—

$$W_B = E_B I = I^2 (R_G - R_M).$$

Thus it is seen that the power exerted by the auxiliary motor M gives the iron and frictional losses, while the power given out by the booster B gives the armature copper losses of the machines.

The power exerted by M may be taken as the difference between the watts taken by it when driving the set and when running light. The power given out by booster B is read directly on an ammeter and voltmeter connected to its terminals.

In this test, both machines under test are adjusted to run at normal speed and excitation; their losses, therefore, correspond to working conditions. The efficiency of either machine can be calculated with a high degree of accuracy, because both carry the same current and are subject to similar losses.

The regulation is observed as the rise in the terminal voltage of the generator which occurs on opening the armature circuit after running on full load.

The test is suitable for all the purposes enumerated above.

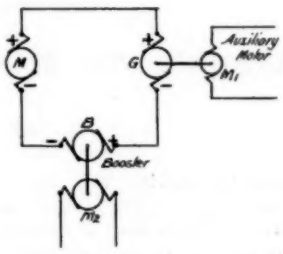


FIG. 1.

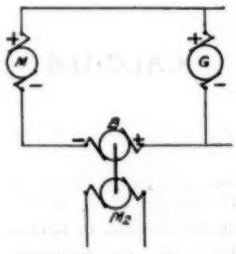


FIG. 2.

Method 2.—*Electrical Drive and Auxiliary Booster.*—In this form of the test the auxiliary driving motor is dispensed with, and the machines under test are connected in parallel to the supply mains (or source of suitable voltage) and take from them the power for producing rotation in the form of electrical energy. The arrangement is indicated in outline in fig. 2. In the absence of voltage in the booster B, both machines would take power from the mains (if equally excited), and would run as motors. The effect of gradually raising the booster voltage is to lessen the current taken by machine G and to increase the current taken by machine M. The current taken by G will gradually fall to zero and then increase in the reverse direction as the booster voltage rises. The current taken by M (as a motor) rises at the same time, and both machines can be made to work at any desired loading. The driving power taken by M from the mains is almost equal to the power generated by G and delivered to the mains.

It may be found necessary in this test to adjust the fields of the generator and motor to slightly different values, in order to maintain normal speed. The iron losses will consequently not be exactly equal for the two machines, and the accuracy of the methods as a test for efficiency suffers in consequence.

The copper losses are supplied by the booster, and may be measured by the terminal voltage and current of this machine.* The iron and friction losses are supplied from the mains, and can, therefore, be measured easily.

* This statement is not quite accurate, as the currents taken by the two machines are not equal, as they were in the previous test.

The regulation of machine G can be measured by adjusting its speed and load to the desired values and then opening the connection between it and the mains. The regulation is given by the rise in voltage at its terminals.

Method 3.—*Electrical Drive without Booster.*—This arrangement is generally the simplest to carry out in practice, and is quite satisfactory for heat runs, though less suitable for accurate measurement of losses, efficiency or regulation. In principle, it resembles Method 2, with the omission of the booster.

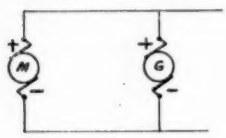


FIG. 3.

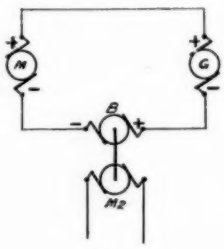


FIG. 4.

Both machines are connected directly to the supply (see fig. 3); speed and load are both controlled by variation of the excitation of the two machines under test.†

† The speed can also be regulated by varying the voltage of supply.

Neither machine works at its normal excitation, while speed and load are not capable of independent adjustment.

All losses are supplied from the mains, and their value is obtained by multiplying the voltage of supply by the difference between motor and generator currents.

If used for calculating efficiency, this method should be employed only on fairly large machines, as the loading on the generator and motor is too unequal when the machines are small.

Method 4.—*Electrical Drive from Booster.*—This method (like the last) is derived from Method 2, but in this case the power mains are dispensed with as a source of supply, and all the losses are derived from the booster. The connections now become those indicated in fig. 4, from which it is seen that the machines are connected in series to the source of supply (*i.e.*, the booster), instead of in parallel (to the mains) as in the previous arrangement.

The additional power to make good the losses is now supplied to the motor by increasing the voltage applied to its terminals instead of by increasing its current (as in Method 3).

The fields of the machines under test must be regulated as the load increases, in order to maintain a constant normal speed. The excitation is, therefore, again not normal. Both armatures carry the same current, so that the conditions of working are more nearly alike.

While this method may be used for obtaining an approximate value for the efficiency, it is most suitable for a heat run.

CALCIUM CARBIDE: ITS MANUFACTURE AND APPLICATIONS.

By "AJAX."

THE first preparation of calcium carbide was due to Wöhler in 1863, who made a highly pure product by the interaction of carbon with a molten alloy of calcium and zinc. Subsequently the work of Heroult (Austria), Morissan (France), and Willson (America) on the subject culminated in the introduction by the last of a commercial process in 1892 and the institution of a factory at Alby, U.S.A. Latterly the development of the carbide and consequently the acetylene industry has been phenomenal, extending to almost every country, particularly where electrical power is economically produced. A number of carbide factories has been erected at Ontario and Quebec, water power being there available at a low rate. The Canadian Carbide Co.'s factories at Shawinigan Falls, Thorold, and Ottawa produce collectively over 12,000 tons per annum, and the world's present production of calcium carbide is estimated at 700,000 tons. Arndt (*Elektrotech. Z.*, 42, p. 264, 1921) states that in 1917 Germany produced 300,000 tons of calcium carbide, and this production was maintained up until May, 1919, when the industry became demoralised, due to economic and political influences. Norway produces 100,000 tons a year, 60,000 of which is converted into calcium cyanamide. The commercial value of calcium carbide is founded on its chemical interaction with water, evolving acetylene, and with nitrogen to form calcium cyanamide, which is a base for nitric acid and ammonia sulphate production. Immense quantities of calcium carbide are now produced in various types of electric furnace. Originally the manufacturing operation was tedious and the product expensive, consequent on large heat losses; during recent years—particularly during the war period—marked economies were effected in the various processes by the introduction of new types of electric furnace, and in the preparation of the crude manufacturing raw materials. Much ingenuity and inventive genius have been shown in the designing of furnaces and labour-saving devices in connection with the handling of the raw and finished material.

Manufacture of Calcium Carbide.—Calcium carbide is now prepared by the interaction of lime and carbon in some form—preferably as coke or anthracite—at a high temperature in an electric furnace, the reaction being reversible and forming a monovariant system, *i.e.*, equilibrium is preserved consequent on a definite pressure of carbon monoxide at a given temperature. The reversibility of the reaction has been shown by the classic experiments of Rothmund (*Zeit. f. Anorg. Chem.*, 31, p. 136, 1902), and Frank (*Zeit. f. Angew. Chem.*, p. 1,734, 1905). Calcium carbide came into prominence as a convenient generator of acetylene gas when mixed with water; it consists of 37.5 per cent. of carbon and 62.5 per cent. of calcium. The temperature of reaction in the manufacture of calcium carbide as given by various authorities varies from 2,000 deg. to 3,000 deg. C., and the reaction is represented by the following equation:

Lime	Carbon		Calcium Carbide	Carbon Monoxide.
CaO	$+ 3C$	$\rightleftarrows$	CaC_2	$+ CO$

It is assumed that the lime is initially decomposed by means of the carbon, which, setting free the calcium, allows the latter to unite with the excess carbon and thus to produce calcium carbide. During the reaction the lime is liquefied whereupon the carbon enters into solution, the process being accompanied with the evolution of carbon monoxide. A high standard of purity is desirable in the raw materials used in the operation, as any foreign matter has a deleterious effect on the course of the reaction as well as on the quality of the finished product. The ash content of the coal should not exceed 4 per cent., and the materials should be particularly free from phosphorus so as to prevent the subsequent formation of phosphine, which produces a cloud when the carbide is used for illumination purposes, and also renders the acetylene liable to spontaneous ignition. The presence of excessive magnesia is to be avoided, as it has been found that anything over 1 per cent.

seriously raises the point of fusion. Aluminium and iron reduce the quality of the carbide, the iron rendering the product dark in colour. The presence of moisture in the raw materials is detrimental to the efficiency of the furnace, the modern practice being to calcine the lime and dry the coal immediately before use. In the actual charge used in the furnace, 100 parts of lime of about 1-in. mesh are intimately mixed with 60 parts of anthracite of about ¼-in. mesh and the whole introduced into the furnace. Russell (U.S.A. Pat. No. 1,271,229) claims that a product of high percentage calcium carbide is obtained if the carbon used is pitch coke made from highly distilled coke-oven coal tar. Regarding the proportion of the ingredients, to produce a ton of calcium carbide, theoretically 1,950 lb. of burned lime and 1,260 lb. of charcoal should be used, but in practice an excess of lime is necessary, 2,000 lb. of lime being treated with 1,200 lb. of anthracite.

Electric Furnaces Used in Calcium-carbide Manufacture.—Direct and alternating currents are now used extensively in various kinds of electric furnace, many of which have capacities up to 30 tons. The large Continental and American furnaces are of the double three-phase alternating-current type, and have a rated capacity up to 10,000 h.p., the energy consumption being 1 h.p. per year per ton of calcium carbide produced. Furnaces of this type are now in operation at Sebinica (Austria), Odda (Norway), Niagara Falls and Saulte Sainte Marie (North America). Excellent results have been obtained by the regulation of the secondary pressure and current in the ratio of 1 :1.5, the primary voltage being a constant and the transformation ratio being changeable. This device overcomes the difficulty of regulating the voltage in an alternating-current system, when several drops are desired and the pressure varies over wide limits. Some of the American factories utilise transformers, the secondary pressure being changed from 60 to 90 volts in 15 steps, the use of a regulating system avoiding the interrupting of the current. In the application of direct current there is probably a double reaction, an electro-thermic one generating the carbide and concurrently an electrolytic reaction with a decomposing tendency. Bingham has shown that the electrolytic action of direct current is counteracted by the higher producing efficiency as compared with alternating current. The yield of calcium carbide being dependent on the watts alone, the type of current should be immaterial. Alternating current may have some advantage, as it does not introduce any impurities electrolytically, and further, it is desirable that carbide furnaces should be fed from special transformers. In the more modern type of furnace, the carbide is allowed to run from the furnace in the molten state; in the older types the base of the furnace is removable or can be rotated out of the sphere of the reaction, and they are usually intermittent in action. Much the larger number of furnaces now in use are of the former kind, and may be divided into two varieties: those with two or more electrodes entering from above, and the second variety having one or more electrodes entering from above and one electrode at the base. Furnaces with upper electrodes alone have a higher electrode consumption than single-phase furnaces, probably due to the constant movement and adjustment, and also the higher voltage, inducing local disturbances during the reaction. Experience has shown that two suspended electrodes are more beneficial than one suspended and one bottom electrode, as in the former case the electrodes may be raised periodically and hence prevent the current passing through the finished product. The base acting as an electrode has also proved to be a structural weakness in the furnace.

In the modern Alby furnace the process is continuous, the product being removed by tapping during the process. One of the electrodes is fixed in the hearth, while the other pole consists of a number of adjustable carbon electrodes fixed to the roof of the furnace. The carbide is drawn away hourly, and this type of furnace is largely used in Norway. In the Tenner type the movable base is in the form of a trough, and acts in the capacity of a negative electrode, the positive one being inserted through the roof. The current used is 2,000 amps. at 100 volts, and the mass is said to attain a temperature of 3,000 deg. C. Engelhardt (German Pat. No. 206,175) suggests the conservation of thermal energy by utilising induction furnaces applying direct or alternating current. In this patent, the carbide is produced by the high temperature attained more than by the direct effect of electricity. The Horry type of furnace which is in use at Niagara Falls is composed of a vertical rotating wheel, the base of which forms an annular receiver. The rotation of the wheel is so adjusted that the carbide after formation is soon removed from contact with the arc. The furnaces have a capacity of 600 h.p., the current being 4,000 amp. at 110 volts, and the furnaces are continuous in action until the electrodes are consumed. In Sweden the Alby furnace has found favour, using a single-phase alternating current of 1,400 kW, with an output of 70 tons per week.

The introduction of polyphase currents for the operation of electric furnaces has effected a marked efficiency as well as an increase in capacity. In some of the modern American furnaces, triple three-phase systems are used, operating nine electrodes in a single hearth, the power consumption being about 15,000 h.p. without increase in load, producing 160 tons of calcium carbide in 24 hours. These furnaces are entirely enveloped, so that the carbon monoxide evolved can be utilised for combustion purposes, and thermal losses are considerably lessened. The three-phase generators used at Odda, in Norway, are directly coupled to turbines, and designed for an output of 9,600 kW at a power factor of 0.8, equivalent to 12,000 kVA at 12,000 volts, 25 periods per second, the magnetising currents being supplied by turbine-driven exciters. At the Cologne A.G. works, producing 1,000 tons a week, the furnaces used are of the open type, and are built of a steel framework, 30 ft. by 15 ft. by 10 ft., with an 18-in. bed of refractory material, the electrodes being 4 ft. by 2 ft. by 8 ft. long, with water-cooled contact heads. The power is supplied by three-phase turbo-generators of 12,000 kW each, and the electrode consumption is about 10 lb. per ton of carbide. Consequent on the introduction of massive transformers there is now a tendency to build furnaces of a much larger capacity. The introduction of multi-phase current has also given much assistance in the distribution of the load on generating stations, it being now proposed to build furnaces of 3,000 h.p. Helfeinstein (English Pat. No. 178,454) proposes a furnace provided with central vertical electrodes, the charging orifices being inclined, the charge forming a trough along the furnace, which contains a double set of electrodes. The carbide, after cooling, is subsequently treated according to the use to which it is to be applied; if for illumination purposes it is broken to a suitable size for feeding into holders. For the manufacture of cyanamide, it is pulverised in an inert atmosphere, by means of gyratory low-speed crushers, and separated by sieving. So as to increase the resistance of the calcium carbide towards atmospheric moisture, the surface of the material is covered with a thin layer of graphite or calcium cyanamide during storage. Alerg. (*Z. angew. Chem.*, May 16th, 1919) proposes utilising the combustible gases produced during carbide manufacture for the calcining of the lime, thereby effecting a considerable economy in fuel.

Electric Furnace Electrodes.—The manufacture of suitable electrodes has been a question of paramount importance to the calcium carbide industry. In many cases the use of furnaces has been considerably curtailed due to unsatisfactory electrodes. Graphitised electrodes are peculiarly suitable to the intermittent type of furnace, where amorphous charcoal electrodes are principally used in the continuous furnace, utilising currents in the larger furnaces up to 50,000 amps. The current density varies between 50 and 10 amps. per sq. in., according to the furnace used and the consump-

tion of the electrode. The lower the voltage, the larger the electrodes which may be used and the amperage carried. At Odda, in Norway, inclined electrodes are in use weighing 4 tons, the hot gases being conducted away and utilised for heating lime kilns. The electrode holders are also so arranged that they absorb but little current.

The specific resistance of cold carbon electrodes should not exceed 0.007 ohm per cu. cm.; the ohmic resistance diminishes as the temperature increases. The thermal conductivity of carbon electrodes is about 0.4 calories per cu. cm.-hour. It is essential that good contact be established between the holder and its electrode, the copper pin sprinkler type being highly commended, as loss of current and danger of explosion are minimised. Baumann (*Chem. Zeit.*, 1920, Vol. 44, p. 33/35) considers anthracite electrodes of a fine-grain structure and a high tone the most serviceable, and also that they diminish the "smoke" effect.

Applications of Calcium Carbide.—The principal use for calcium carbide is as a source for the production of acetylene, which has found such wide applications industrially for illumination purposes, flares, air-acetylene and oxy-acetylene flames for the autogenous welding of iron, the temperature of the air-acetylene blow-pipe flame being 2,000 deg. C., and that of oxy-acetylene 4,000 deg. C.; also for the production of acetaldehyde, alcohol, acetic acid, acetone, and chloroform, using mercury salts as catalysts. Calcium carbide is used on the commercial scale for the fixation of atmospheric nitrogen, and recently considerable research work has been done and patents granted to the Chem. Fabrik. Griesheim-Elecktron and to the Cons. fur Electro-Chem. Industries G.m.b.H. in connection with the manufacture of non-inflammable solvents by the use of halogen derivatives of acetylene. One of the more important is acetylene-tetrachloride, which is non-inflammable and an excellent solvent for fats, varnishes, sulphur, phosphorus, &c., and is patented under the name of "Acetosol." Other derivatives are also proposed, such as tetra- and penta-chlorethylene and trichlorethane, which are claimed to be less toxic than acetylene-tetrachloride. The copper derivative of acetylene is an important ingredient of electrical detonators. The Aktie Selskabet Karbid Industrie has been established recently at Fredrikstad, Norway, with a view to the manufacture of alcohol and acetic acid from calcium carbide. The acetaldehyde produced from the acetylene provides a suitable base for the manufacture of alcohol, chloroform, acetone, and artificial rubber. It is asserted that this plant has already a daily output of 4,000 kilos of acetaldehyde, calcium carbide now being a first-rate electro-chemical industry in Norway. It is proposed to manufacture synthetic rubber by first preparing the acetone from acetylene, reducing the latter to pinacol by means of aluminium, and converting the residue into dimethylbutadiene; it is claimed that the product is denser and has better insulating properities than natural rubber. A German factory is already in operation, and by using this method produces five tons of rubber daily. In Switzerland alcohol is manufactured from acetylene, and competes in price with the fermentation alcohol, due to the low cost of power. In 1918 Switzerland produced 90,000 tons of calcium carbide (*Eisenwarenhandel.* Aug., 1919).

The preparation of argon on a commercial scale is now conducted by the aid of calcium carbide. A mixture of carbide with 15 per cent. calcium chloride at 800 deg. C. absorbs oxygen and nitrogen vigorously, producing lime and calcium cyanamide, the argon being left unabsorbed. Recently acetylene has been used for power purposes, particularly for starting up motor-car engines and for high-power motor boats. Tests have shown a consumption of 6 cu. ft. acetylene per h.p.-hour. The objection is the high pressure exerted due to the violence of the explosion of the air-acetylene mixture. Calcium carbide has found considerable use for the manufacture of calcium cyanamide by passing nitrogen over heated calcium carbide at a temperature of 900 deg. C., the reaction being strongly exothermic; the carbide need not be of a high degree of purity. At Niagara the nitrogen was made originally by passing air over heated copper, the output of the factory being 10,000 tons annually; the nitrogen is now obtained by means of an air-liquefaction plant. At Cologne the nitrogen is supplied by a Linde liquid-air plant. The crude calcium cyanamide is termed lime-nitrogen, "nitrolim" or "Kalkstickstoff," and is used as a fertiliser, its principal decomposition products being ammonia and calcium carbonate; certain organisms are also capable of decomposing cyanamide into urea and finally into ammonia carbonate. The use of "nitrolim" as a fertiliser is rapidly advancing, the Odda factory alone producing 15,000 tons annually. Cyanamide is also used for the production of nitric acid by the Ostwaldt process, whereby when cyanamide and water are heated they produce ammonia, the latter being oxidised in the presence of platinum catalysts to nitric acid.

Amongst other applications of calcium carbide are its use as a deoxidising flux—when in admixture with borax—for copper and copper alloys, leaving the metal free from carbon and its electrical conductivity unchanged; in the glass, colour, and black-metal industries, calico-printing, ink production, and in the manufacture of miners' lamps and cyanides.

The governing factors of commercial success in the carbide industry are that the site of the factory should be chosen with discretion, having due regard to the availability of lime or limestone; power must be cheap and anthracite obtainable at a low rate. The electrical arrangement should be controlled by the power available, the source of which is generally some distance away. High-voltage transmission is usually applied, and transformation effected near the furnaces; the voltage required is low, usually from 40 to 50 volts, hence it necessitates a short low-pressure cable to carry the immense current. The large calcium-carbide factories are situated where ample water power is available, the most successful factories being those conducting operations on an extended scale, and hence able to produce at a relatively low rate. The huge industrial development of the carbide industry within recent years has considerably increased the demand and lessened the cost of production, and has now probably reached the minimum figure at which the industry could be conducted commercially.

Gas Out of Date?—At the meeting of the London County Council on Tuesday last, Mr. Morrison moved "That it be referred to the Public Control and General Purposes Committees to consider and report as to (*a*) whether or not legislative or other steps should be taken to secure that the gas companies should not spread illness and death by poisonous fumes whether as a consequence of imperfect gas or faulty mains or pipes inside or outside buildings; and (*b*) whether or not recent enterprise on the part of the electricity undertakings of the Metropolitan borough councils of Hackney, Poplar, St. Marylebone, Stepney, and Woolwich tends to show that gas is no longer necessary to the running of a house either in respect of lighting, heating, or cooking."

In an interview with a representative of the *Evening Standard*, Mr. Morrison said that within ten years a complete change would be effected in domestic methods. In Hackney it had been found that electricity was cheaper than gas for cooking purposes.

The Training of Chinese Students.—With reference to our recent leading article on British engineering training for Chinese students, a letter appeared in *The Times* (January 18th) from Messrs. S. N. Fu and T. F. Chang (of the Inland Chinese Students' Society in London) stating that the Chinese students here believe that co-operation with the Chinese educational leaders is essential for securing success in employing the Chinese Boxer indemnity funds as suggested. They consider that the effects of employing parts of the funds for missionary schools are doubtful, and they add: "There are a number of capable Chinese institutions which are recognised intellectual centres in China. Best results can be achieved by establishing institutes, laboratories, and professorships, together with the necessary equipments and scholarships, in a somewhat autonomous manner, within these institutions."

THE LEGAL RESPONSIBILITIES OF DIRECTORS.

(From a Legal Contributor.)

There is no doubt that the facts brought to light in a *cause célèbre* have occasioned considerable uneasiness amongst that numerous body of persons who are interested in limited liability companies. The circumstances which led up to the case referred to have their warning and their lesson for directors and shareholders alike. They serve to remind the director that he must not be a passive spectator of what goes on in the councils of his company, and that, although his mere inattention to business may not render him criminally liable, his neglect may place him in a position of considerable difficulty. With regard to the shareholder, he may well ask himself, after reading the reports of this case, What of the companies in which my savings are invested? Who are the directors? What are their qualifications? What steps can I take, or could I have taken, to secure that proper directors are chosen to sit upon the Board?

If it is generally important that all directors of all public companies should hold suitable qualifications, the need is greater in the case of those technical companies with which this journal is more nearly concerned. Matters electrical are not easily understood—even by the ordinary man of business. Still less are they necessarily within the comprehension of the proud possessor of a title who is glad to allow his name to appear on the front page of a prospectus and do nothing more except draw his breath and his pay. Again, amongst those directors of electrical companies who hold a proper technical qualification, there may be some who have an inadequate, or, it may be an erroneous, conception of the duties which devolve upon them.

In these circumstances it may be convenient to say something of the powers, duties, and liabilities of a director in order that those who hold this office may be able to more clearly understand their position. This is the more necessary because it was stated in the House of Commons on December 12th that the Board of Trade does not consider that any amendment of the existing law is required.

He who is invited to become a director of a public company should, in the first place, be satisfied that all statements in the prospectus of the company can be fully substantiated. Otherwise the consequences may be serious.

It is provided by Sec. 84 of the Companies Act that where a prospectus invites persons to subscribe for shares in or debentures of a company, every director of the company at the time of the issue of the prospectus, and every person who has authorised the naming of him and is named in the prospectus as a director or as having agreed to become a director either immediately or after an interval of time, and every promoter, is liable to pay compensation to all persons who subscribe for any shares or debentures on the faith of the prospectus for the loss or damage they may have sustained by reason of any untrue statement therein, or in any report or memorandum appearing on the face thereof, or by reference incorporated therein or issued therewith, unless it is proved (*a*) With respect to every untrue statement not purporting to be made on the authority of an expert, or of a public official document or statement, that he had reasonable ground to believe, and did believe, up to the time of the allotment of the shares or debentures that the statement was true; and (*b*) With respect to every untrue statement purporting to be a statement by or contained in what purports to be a copy of or extract from a report or valuation of an expert, that it fairly represented the statement, or was a correct and fair copy of or extract from the report or valuation. Provided that the director, person named as director, promoter, or person who authorised the issue of the prospectus, shall be liable to pay compensation as aforesaid if it is proved that he had no reasonable ground to believe that the person making the statement, report, or valuation was competent to make it; and (*c*) With respect to every untrue statement purporting to be a statement made by an official person or contained in what purports to be a copy of or extract from a public official document, that it was a correct and fair representation of the statement or copy of or extract from the document; or unless it is proved (i) that, having consented to become a director of the company, he withdrew his consent before the issue of the prospectus, and that it was issued without his authority or consent; or (ii) that the prospectus was issued without his knowledge or consent, and that on becoming aware of its issue he forthwith gave reasonable public notice that it was issued without his knowledge or consent; or (iii) that after the issue of the prospectus and before allotment thereunder, he, on becoming aware of any untrue statement therein, withdrew his consent thereto, and gave reasonable public notice of the withdrawal, and of the reason therefor.

The section goes on to provide that where the prospectus contains the name of a person as a director of the company, or as having agreed to become a director therein, and he has not consented to become a director, or has withdrawn his consent before the issue of the prospectus, and has not authorised or consented to the issue thereof, the directors of the company, except any without whose knowledge or consent the prospectus was issued, and any other person who authorised the issue thereof, shall be liable to indemnify the person named as aforesaid against all damages, costs, and expenses to which he may be made liable by reason of his name having been inserted in the prospectus, or in defending himself against any action or legal proceedings brought against him in respect thereof. A perusal of this section of the Companies Act shows that a man who allows his name to appear on a prospectus is exposed to certain risks which may prove to be very serious. He ought not, therefore, to allow his name to be used unless he has made all proper inquiries as to the credit and reliability of those with whom he is to be associated on the Board.

Passing on to consider the position of a director of an established company, it may be stated that in carrying out his duties a director should (at the very least) devote the same attention to business as he would give to the prudent management of his own affairs. We say "at the very least," because it may well be that his moral obligation is somewhat higher. He is acting in a fiduciary capacity, and although the shareholder has the right to attend and voice his protest at the general meeting, it is common knowledge that he nearly always stays away, and that, even if he does attend, his is but a voice crying in the wilderness of proxies!

"The true position of directors is that of agents for the company. As such they are clothed with the powers and duties of carrying on the whole of its business, subject, however, to the restrictions imposed by the articles and any statutory provisions." (Halsbury's "Laws of England," Vol. V, p. 220.)

As to responsibility for the actions of his co-directors, the position of a director is as follows. He is liable for the acts of his co-directors if, knowing that they intend to commit a breach of trust, he does not, by applying for an injunction or otherwise, prevent it. A managing director is equally responsible, although required "to act under the orders and directions of the Board." But a director is not so liable where he does not know of

the breach of trust before or at its occurrence, and does not expressly or tacitly concur in its continuance. Merely attending a directors' meeting which confirms the illegal acts of a past meeting is not sufficient to fix responsibility. Sec. 215 of the Companies Act provides that where, in the course of winding-up a company, it appears that any past or present director has misapplied or retained or become liable or accountable for any money or property of the company or been guilty of any misfeasance or breach of trust in relation to the company, the Court may, on the application of the official receiver, or of the liquidator, or of any creditor or contributory, examine into his conduct and compel him to repay or restore money or property, with interest at such rate as the Court thinks just, or to contribute such sum to the assets of the company by way of compensation in respect of the misapplication, misfeasance or breach of trust as the Court thinks just. It has been decided, however, that directors cannot be made liable under this section for mere non-feasance—as, for instance, by non-attendance at Board meetings; and in another case it was held that it is not part of the duty of a director to attend at every meeting of the Board or to take part in every transaction which is considered at a Board meeting. To quote Halsbury's "Laws of England" once more: "Facts which may show imprudence in the exercise of powers clearly conferred upon directors will not subject them to personal responsibility unless the imprudence amounts to crass negligence. If they act within their powers they are not liable for loss to the company occasioned by mere imprudence or error of judgment, and especially in matters of investment they need not act with the care of trustees."

In certain cases, however, the Court has power to grant a considerable measure of relief. Thus, by Sec. 279, if in any proceeding against a director, or person occupying the position of director, of a company for negligence or breach of trust it appears to the Court hearing the case that the director or person is or may be liable in respect of the negligence or breach of trust, but has acted honestly and reasonably, and ought fairly to be excused for the negligence or breach of trust, that Court may relieve him, either wholly or partly, from his liability on such terms as the Court may think proper.

Enough has been said to show that it is by no means easy for a shareholder to call the conduct of a director in question, or to make him personally liable for the improper conduct of the Board as a whole. This state of affairs renders it the more important for every director who is anxious to carry out his duty honestly to exercise a prudent supervision over the managing director and his co-directors; and to let no resolution be passed without his assent or, at any rate, without his knowledge.

If some of his colleagues, or the managing director, are not "playing the game," there are various means by which a director may thwart them and protect himself. It often happens that large powers are conferred upon the managing director; but the practice of leaving everything to one man should be avoided unless he has proved himself to be entirely trustworthy. Again, an eye should be kept on the secretary. He should never, in the first place, be allowed to be a director, and his relations with the managing director should be all open and above board.

But it is by a punctual and regular attendance at the meetings of the Board that a director can best find opportunity to make his influence felt in the conduct of the affairs of the company. He should be careful to see that the minutes are a faithful record of what takes place at these meetings. The Companies Act provides that:

(1) Every company shall cause minutes of all proceedings of general meetings and (where there are directors or managers) of its directors or managers to be entered in books kept for that purpose.

(2) Any such minute, if purporting to be signed by the chairman of the meeting at which the proceedings were had, or by the chairman of the next succeeding meeting, shall be evidence of the proceedings.

(3) Until the contrary is proved, every general meeting of the company or meeting of directors or managers in respect of the proceedings whereof minutes have been so made shall be deemed to have been duly held and convened, and all proceedings had thereat to have been duly had, and all appointments of directors, managers, or liquidators shall be deemed to be valid.

It will be noticed that there is nothing here to *compel* the chairman to sign the minutes nor is it enjoined that the minutes of what takes place at one meeting shall be read over and confirmed at the next. In practice, of course, this procedure is generally adopted, and it is of enormous importance that it should be closely followed. In the first place it, to some extent, ensures that the minutes shall be an accurate record of what took place. It is sometimes said that he who drafts the minutes rules the meeting; but when the minutes are read over an opportunity is afforded to correct any mistake which may have crept in. The importance of making any necessary correction will be manifest when it is realised that the minutes, when signed by the chairman, are evidence of what took place at the meeting. A check is thus placed upon possible collusion between the chairman and the secretary. Again, the reading over of the minutes of a previous meeting gives any director who was unable to be present an opportunity of finding out what took place in his absence.

Finally, the perusal of the minutes, and a comparison between them and the agenda for the meeting of which they purport to be an accurate record, may disclose the fact that some resolution was carried which was not on the agenda, or that some resolution was not dealt with at all.

MESSRS. C. A. PARSONS'S WORKS REVISITED.

Some Notes on Present-day Practice.

Last week we noted that the Commonwealth Edison Company of Chicago, which had purchased a 25,000-kW Parsons turbo-generator in 1912, and had found it very satisfactory, had ordered one of 40,000 kW from the same manufacturers, "in order to gain experience of the latest developments in steam turbine practice in this country." As we recently paid a brief visit to Messrs. C. A. Parsons's works at Heaton, Newcastle-on-Tyne, some particulars of what we saw there may be of interest in this connection.

For some time Messrs. Parsons have been developing the closed-circuit system of ventilation for their alternators; this involves the use of an air-cooler, and for this purpose they have devised a multi-tubular cooler with gilled tubes, necessitating the adoption of special ferrules to enable the tubes to be inserted through the tube-plates. The ventilating system of the alternator is so arranged that the air is admitted through the base of the machine, passes through the ventilating channels, and leaves again by way of the bedplate. The cooler is housed in the alternator foundation block, with the fan closely adjoining. With cool circulating water, the temperature of the cooling air can be kept lower than that of the surrounding atmosphere in hot climates. The cooler is made in sections which can be removed individually for overhead without stopping the alternator; and the water-box covers can be removed individually for the purpose of cleaning the tubes without removing the cooler sections.

Turning to the construction of the stator, the distance-pieces between the core plates are of high-resistance iron, of channel section, spot-welded to the plate. The windings of the stator are contained in closed slots, slightly spiralled, with the result that the wave-form is very approximately sinusoidal, the reactance being about 15 per cent. Whenever it is possible, divided bars are used, giving a larger cooling surface to the end connections, which also are widely spaced; a liberal amount of insulation, with a long surface to prevent creepage, is provided. The bars are wound with mica sheeting on an extremely ingenious machine, resembling in principle the pocket cigarette-making machines which used to be popular. The mica wrapping is built up with varnish on fine Japanese paper; it is regarded as undesirable that the insulation should ever become dead hard—if it is soft it ensures tightness in the slots, and yields to the expansion and contraction of the bars. The end connections of the stator are steadied with a wooden ring an inch or two from the core, to prevent racking strains coming on the insulation where the bars emerge from the slots, and the end plates of the core have specially strong fingers to clamp the core-plates together between the slots. Grooved wooden blocks and metal braces hold the end connections securely in place, and the joints in the conductors are made on a very sound principle. By the use of stranded conductors, eddy currents in the windings are reduced to the minimum. Care is taken to provide a wide spacing between the phases, as well as between turns, and whenever possible the stators are built in one piece and wound before dispatch, a special railway truck being used for large machines. The stator leads are specially insulated, supported, and clamped, and are brought out in front of the end connections. The wooden blocks used for supporting the windings are specially dried and impregnated; and the end connections are accurately formed to shape before being insulated and mounted.

The conductors for the stator windings are stranded by Messrs. Parsons themselves in a special machine; each wire is single-cotton-covered, and the wires are laid up in a flat cable, making a beautiful job. No right-angle corners are permitted on the outer edges of stator bars. Much use is made of impregnating tanks and baking ovens, and great care is taken in the manufacture on the premises of varnished linen, which is varnished and baked alternately until sufficiently resistant.

The rotors are solid steel forgings, carefully annealed and inspected; in order to detect internal defects, a continuous watch for the "clink" which is heard when a blow-hole is formed inside the forging is maintained, day and night, whilst the mass is being annealed.

The rotor coils are wound on edge with the aid of an ingenious machine, which is readily adjustable to suit any size of strip or coil; the slight thickening which necessarily occurs on the inner side of the bends is neatly shaved off in the same machine, and the spacing of the turns is so regulated that they fall naturally into position in the act of placing them on the curved periphery of the rotor, which has open slots. Steel or brass wedges are used for securing the coils in the slots, and are serrated in order to increase the cooling surface. Extra insulation is provided on the conductors at and near the ends of the rotor slots. The rotors are balanced both statically and dynamically, machines for the latter purpose being provided which enable the rotors to be run up to any desired speed. The bobbins for the exciter field magnet windings are each moulded complete in one piece, of asbestos and bakelite.

On the turbine side the most interesting feature was a new method of manufacturing turbine blades, which, we understand, are rolled integral with the root. The Parsons "End Tightened" reaction blading, described in our issue of July 9th, 1920, has now become well-known; with its aid, the efficiency of 10 lb. steam per kWh obtained in 10,000-kW turbines is maintained permanently, and the mechanical reliability of the machine is immensely improved by the elimination of fine radial clearances. In view of the modern tendency to raise the pressure and temperature of steam, and consequently to enhance the severity of the working conditions in the turbine, the advantages of this system of blading tend to increase. Another factor of importance is the practice of designing turbo-generators to run at the highest permissible speed; for a frequency of 50 cycles this means 3,000 r.p.m. with direct coupling, but a large number of turbines are built nowadays for driving both d.c. generators and alternators through speed-reduction gearing, in which cases the turbine may run at a speed of 6,000 r.p.m. or more, and the reliability of the newer type of blading becomes consequently of still greater value.

Ample facilities are provided in the test-room for making oscillograms and carrying out all other necessary tests.

At the time of our visit a large number of machines were in course of construction; the works had been considerably extended since our last visit, and the system of power distribution was being changed over from d.c. to three-phase.

AUSTRALIAN NOTES.

We are indebted to our contemporary, the *Industrial Australian & Mining Standard*, for the material forming the the following article which deals with recent developments and movements in Australia.

The Victorian Electricity Commissioners have presented a complete report upon the proposal to utilise the waters which flow from the Sugarload Reservoir, Rubicon and Royston's Rivers, and Snob's Creek, to generate electricity. The scheme is estimated to cost about £962,320, the various items being as follows:—Hydraulic work, power stations, &c., £555,370; tower transmission line from the Rubicon station to Bundoora, with terminal station and apparatus, £241,800; pole transmission line from Sugarloaf to Benalla with branches to Wangaratta and Shepparton, with sub-stations and apparatus, £169,150. The Commissioners propose that as no less than 28 municipalities would be supplied by the scheme, and thus be interested in low-pressure distribution, it is essential that a single controlling body should be formed to deal with the distribution of the power generated. Whether this should be undertaken by the Commissioners themselves, who are suitably equipped for such a task, or whether a separate trust or commission should be formed for the purpose is a matter for the Government to decide. The Commissioners have no strong views one way or the other. It is recommended that construction be commenced forthwith, the transmission lines being erected at once to enable the northern district to be supplied, temporarily, from the Morwell (brown-coal) station until the hydro-electric scheme is working. It is also considered that no further surveys of water-power resources need be carried out at present in the Strathbogie district.

The position of the Victorian Commissioners was severely attacked recently by Mr. C. S. Demaine, a consulting engineer, especially with regard to the State Electricity Commission Bill, which is a measure extending the Commissioners' powers. It is characterised as a Bill to give the "Commission" power of attorney to do what it likes, in any way it likes, without reference to Parliament." It is said that although Section 2 of the Bill expressly exempts from the jurisdiction of the Commission any municipality within 25 miles of the City of Melbourne, the Commissioners are already doing within that radius all the things that the Bill provides for outside the area, and, moreover, are daily extending their activities there. It is said that although the Commission will only cost £10,000 per annum, they will have unlimited spending power, and will be able to commit the State to the subsidisation of schemes for ten-year periods. These powers are granted on the assumption—on the strength of the Commission's estimates—that a certain scheme is going to pay. The Bill is based on estimates and favourable assumptions. The system of subsidies set up by the Bill is designed, says the critic, to "rob Peter to pay Paul," *i.e.*, to cause a "paying" district to assist in the subsidisation of a "non-paying" district. The Government's liability in respect of losses incurred by electricity undertakings is restricted to £10,000 per annum, but Mr. Demaine wishes to know how the rest of the losses are to be made up. He quotes an instance—the Geelong-Warrnambool line—where the annual losses will exceed £10,000 for the "magnificent privilege" of electricity in bulk at 3.6d. per kWh which will certainly not encourage industry. He concludes by saying that if the Bill is sponsored by the Government then a decidedly anti-Socialist Government has succeeded in performing the most Socialistic feat attempted by a State Parliament in the history of the Commonwealth.

The recent outcry against compulsory industrial arbitration led the South Australian Government to introduce a Bill for its discontinuance, but the amendments proposed was so drastic and the substituted procedure was so unfavourably received that the Government was forced to withdraw the measure. The Bill provided for the abolition of the Industrial Court, the Board of Industry, and existing Industrial Boards. This, incidentally, would have done away with the compulsory basic wage, and compulsory awards regarding wages and conditions of employment. The Bill was not purely destructive, however, as it provided for the appointment of a Registrar of Conciliation Boards, whose duty would have been to receive applications from employers or employés for the appointment of a conciliation board to consider disputes. He would have reported to the Government, who would have set up such a board within 14 days of the receipt of the application. The boards were to have consisted of one representative each of the employers and employés affected, and these two would have chosen a chairman. The Bill provided that only disputes affecting 50 men or more might be dealt with by this procedure. Members of the conciliation boards were to have been paid for their services. Any agreement arrived at was to have been binding upon both parties, and penalties were provided for contravention. Lock-outs and strikes were to have been prohibited before and during the reference of a dispute to a conciliation board, and picketing was to have been made illegal. Mr. Gunn, the leader of the South Australian Opposition, stated that the Bill would be productive of more strikes than ever before, and he alleged a breach of confidence by the Government, who during the last election said that no alteration in the industrial code was necessary.

The 1921-22 report of the Commissioner of Railways on the Western Australian Government Electricity Supply shows a satisfactory improvement, and although it was recently reported that the Government intended to sell all non-paying State undertakings it appears unlikely that this will be one of them. The revenue rose from £92,312 to £118,775, and the working expenses from £74,978 to £87,582, giving a gross profit of £31,193 as against £17,334. In spite of heavier interest and depreciation charges there was a deficit of only £566—£9,000 less than in the preceding year. The energy sold was almost 20 per cent. greater in quantity than that of 1920-21. Conditions in Great Britain and Australia are not equal so that either nothing or a great deal is conveyed by the statement that the total costs per kWh at the Perth station were 1.057d. as compared with 1.495d. at Sheffield, 1.835d. at Leeds, and 1.900d. at Glasgow.

The plant capacity is at present about 12,000 kVA. but the erection of a fourth set of 7,500 kW is nearing completion. A synchronous condenser installed during the year has considerably increased the transformer power-factor and made available about 500 kW of transformer capacity. Regulation of transmission lines has also been improved to a great extent by the machine.

ELECTRON EMISSION—THE THORIATED TUNGSTEN FILAMENT.

Recent discoveries in electron emission and current-control were described in a series of three lectures by Dr. Irving Langmuir, at the Carnegie Institute of Technology, Pittsburgh, and were abstracted in *Science*, from which we reproduce the following:—

Electron Emission from Heated Metals.

When metals are heated in high vacuum, electrons, or atoms of negative electricity, evaporate from their surface. If there is another electrode in the evacuated space which is given a positive charge the electrons drift over to this electrode (anode) so that a current flows between the two electrodes. Dushman has recently derived an equation which should supersede the well-known Richardson equation, giving the relation between the electron current and the temperature of the cathode. The advantage of this new equation is that there is only one constant which we need to know for each different cathode material, instead of two constants which were necessary for the Richardson equation.

The electron emission from a large number of different materials has recently been measured. The thoriated tungsten cathode gives a current at a temperature of 1,500 deg. absolute, which is about 130,000 times greater than that from ordinary tungsten. Measurements have also been made of cathode materials that have even much greater emissions.

In order to get all the current that a cathode is capable of giving, it is necessary to apply to the anode a voltage high enough to overcome what is known as the "space charge effect." By putting in gases, positive ions are formed in the space between the electrodes, and these neutralise the negative space charge and allow the current from the cathode to pass across the space with much lower anode voltages. In other words, the effect of gases is to increase the current-carrying capacity. Such an effect is used in the Tungar rectifier. Care must be taken what gas is used for the purpose, for many gases have the effect of poisoning the cathode, and cutting down its emission to a small value.

If very high voltages are used on the anode, so as to produce intense electric fields, it is possible to pull electrons out of the cathode. In fact, it is possible to pull electrons even out of cold cathodes, that is, cathodes at ordinary temperatures. The currents obtained this way from the cathode come from very minute areas, but in these areas the current density amounts to more than one hundred million amperes per square inch.

Electron Emission from Thoriated Filaments.

The thoriated tungsten filament is a tungsten filament containing one or two per cent. of thorium, usually in the form of oxide. When such a filament is heated to about 3,500 deg. Centigrade, a little of the thorium oxide is changed into metallic thorium. In the meantime, however, any thorium on the surface of the filament evaporates off, leaving only pure tungsten. If the filament temperature is then lowered to about 1,800 deg., the thorium gradually wanders or diffuses through the filament, and when it reaches the surface, if the vacuum is very perfect, remains there and gradually forms a layer of thorium atoms which never exceeds a single atom in thickness. The thickness of this film is therefore about 1/100,000,000 of an inch, and yet this film increases the electron emission of the filament more than one hundred-thousand-fold.

This useful film is very sensitive and needs some protection to keep it in good condition. Very slight traces of water vapour or other gases would oxidise this film and destroy it. This can be avoided by putting in the bulb some substance that will combine with the water before this has a chance to attack the thorium film. Such a substance is metallic magnesium. Furthermore, it is necessary to avoid heating the filament to too high a temperature, for otherwise the film might evaporate off. It is therefore best to operate such filaments within a rather narrow range of temperature close to 1,700 deg. C., where the ratio of evaporation is very small, and where the temperature is high enough for the thorium gradually to diffuse to the surface and continually repair any damage done by the effect of slight traces of residual gases.

The thoriated tungsten filament opens up many new fields of scientific investigation. By measuring the electron currents, it is possible to determine accurately exactly how much thorium is present on the surface. An amount of thorium corresponding to only 1/1,000 of the surface covered with a layer one atom deep is easily measurable in this way. It is possible to knock off a thorium film by bombarding it with positive ions, moving at high velocities, and in this way the true nature of this bombardment can be determined.

Methods of Controlling Electron Currents in High Vacuum.

Most of the applications of high-vacuum tubes have depended upon the control of electron currents, as, for example, by the grid in the three electrode tube. The action of the grid is due to the charge on the grid modifying the space charge effect. This is the action that is employed in practically all tubes to-day for radio-transmission and receiving. There are many other methods, however, of controlling electron currents. A very important method is that used in the Magnetron, where there are only two electrodes in the evacuated space and the control is obtained by means of a magnetic field generated by an external coil of wire. A still simpler form of Magnetron suitable particularly to very large power tubes, consists of a very large filament in the axis of a cylindrical anode with very large straight filaments. The magnetic field produced by the current through the filament is enough to prevent electrons flowing between cathode and anode. By heating the filament with alternating current, the current periodically falls to low values and at these times current can flow to the anode. This gives a pulsating or oscillating current, which can be used for radio-transmission. A 1,000-kilowatt tube of this kind is in process of development; preliminary tests have been in every way satisfactory.

Another form of tube by which electron currents can be controlled is the dynatron. This depends upon subjecting one of the three electrodes in the tube to electron bombardment in such a way as to cause electrons to be splashed out of it, just as water can be splashed out of a cup by attempting to fill it too rapidly from a faucet. A tube of this kind acts like a real negative resistance, and can be used for producing electrical oscillations with considerable efficiency.

One of the most important applications of electron discharges from hot cathodes is in the Coolidge X-ray tube which is now almost universally used as a source of X-rays. These tubes were first made about 1913 and are gradually being improved in many respects. The latest type of tube, suitable for use by dentists, is a small tube weighing only a few ounces, and only about three inches long. Because of the special features of this tube, the entire X-ray outfit, including the transformer, lead screen, regulating apparatus, &c., weighs only a few pounds and takes up a space of only a small fraction of a cubic foot. One very great advantage of this new form of tube, besides its convenience, is its absolute safety, even in the hands of inexperienced operators, for there are no high voltages in any part of the apparatus which is accessible.

LEGAL.

Possession of Property.

AT Ossett (Yorkshire) Borough Police Court, last week, the Yorkshire West Riding Electric Tramways Co. was granted possession—by an order to be operative within 28 days—of a house at 79, Horbury Road, Ossett, which was its property, and had been purchased for the residence of a district inspector. The occupier, Levi Turner Crowther, had been the inspector, but was not now in the company's employ, and the house was required for the man who had taken his place, it being declared that it was imperative that the inspector should be on the spot. The defendant said he had lived in the house 15 years, and contended that there was no special connection between the house and the inspectorship duties. The order was made, as stated.

British Thomson-Houston Co., Ltd. v. A. & A. Electrical Co., Ltd.

MR. JUSTICE ROMER, in the Chancery Division on Friday, gave judgment, by consent, on a motion by plaintiffs for an injunction restraining infringement of the plaintiff company's patent for incandescent electric lamps.

Mr. Whitehead appeared for the plaintiff company, and Mr. King (who gave the consent) for the defendant company.

Attorney-General v. Southport Corporation.

IN the Court of Appeal, before the Master of the Rolls and Lords Justices Warrington and Younger, on January 17th, was heard the appeal of the plaintiff, suing at the relation of the Birkdale District Electric Supply Co., from the judgment of Mr. Justice Eve, in the Chancery Division, dismissing the action which was brought for an injunction to restrain the defendants from supplying electricity for traction in the urban district of Birkdale or for the lighting the public lamps there.

A report appeared in the ELECTRICAL REVIEW of July 14th (p. 49) and July 28th (p. 122).

Mr. Maugham and Mr. Guest Mathews appeared in support of the appeal, and Mr. Tomlin, K.C., and Mr. Bischoff for the respondent Corporation.

MR. MAUGHAM explained that in 1912 Southport absorbed Birkdale, previously a separate district. On this taking place the Southport Corporation became liable under all contracts by which the Birkdale Urban District Council was bound, and the contention in this case was that on the construction of one of such agreements and of Sec. 23 of the Electric Lighting Act, 1909, the Corporation of Southport was entitled to supply electric energy for the purpose of tramways in what was lately the urban district of Birkdale. The contention of the relators was that both by contract and by Act of Parliament the Urban District Council of Birkdale was precluded from supplying electric energy for the purpose of driving these cars or for other purposes, and the Corporation of Southport was in the same position.

MR. TOMLIN submitted that the Corporation was in the position that it could make use of any energy it generated. Such use was not a "supply" within the meaning of the Act. "Supply" meant giving something to another person, and the use by the Corporation of electric energy generated by itself could not be converted into a "supply" because statutory permission might be necessary for transmission.

Their Lordships reserved judgment.

Worcester Corporation v. Baker.

AT the Worcester police court, last week, James Clarke Baker (46), ironmonger, the Bungalow, Whittington, was summoned for unlawfully supplying to another person electricity supplied to him by the Worcester Corporation, and with causing to be laid an electric line without the consent of the Corporation, and with using electricity at a workshop in Farrier Street.

The TOWN CLERK, who prosecuted, said the first charge related to supplying light to a doctor's garage; the second that defendant laid wires connecting with the Corporation wires without consent; and the third that he improperly used for lighting current supplied to him for power purposes. The Town Clerk explained that if he had applied to the Corporation for its consent a separate meter would have been fixed, because the charges for energy for power and lighting were different. Defendant knew that fact, because he formerly held premises in the Tything. There was a failure of supply at defendant's premises, and when a man went to investigate, he found that lamps were fixed to the power supply and, later, that a wire passed into a garage, and that the current was being used there for lighting purposes.

The defence, put forward by Mr. HARRISON, was that the prosecution was unwarranted, and it had brought upon Mr. Baker a great amount of publicity which should not have been brought upon him. He was a prominent business man, and had not time to see whether the Corporation had carried out its work properly. When the error was pointed out to him he said, "I didn't know this. I am quite willing to pay." Mr. Baker said that the electrical fittings of his old workshop in the Tything were removed *en bloc* to his new shop by a qualified electrician. He then rang up the electricity works and said that he was ready for the current. As far as he knew the two meters—one for power and one for light—were installed. Witness never heard from the electricity works, or had any papers to sign from them. He thought he was having two accounts—one for light and one for power.

The Bench decided that a technical offence had been committed, and they thought the justice of the case would be met by defendant's paying the costs, 5s. on each of the three charges.

Medway's Safety Lift Co., Ltd. v. Scarborough Hotels, Ltd.

IN the King's Bench Division, before Mr. Justice Sankey recently, plaintiffs claimed from defendants £300, the price of goods supplied and work done in repairing a lift at the Grand Hotel, Scarborough. Plaintiffs said that the repair work was properly done, and if there was any stoppage it was due to causes outside the work done by them. Defendants said that the plaintiffs gave an estimate to put the lift in "perfect working order," but that it broke down as many times after the repairs were carried out as before. Counsel for the defence said that one of the reasons suggested by the plaintiffs for any failure in the lift to work was a defective electric supply, but evidence was given for the defence by the manager of the Scarborough Electric Supply Co. In giving judgment the judge said he thought that the plaintiffs' witnesses were mistaken as to there not being an adequate electric supply, but he accepted their evidence that the work was properly done and a reasonable price charged. Judgment for plaintiffs for £306 with costs.

Bath Corporation v. Sidney & Ellis.

AT Bath on January 18th, Edward Cecil Sidney, and Griffiths Ellis, electrical engineers, of the firm of Messrs. Sidney and Ellis, were each fined £2 10s. and costs for using electric current for lighting purposes which was bought at the power rate of 2d. per kWh instead of at the lighting rate of 8d. per kWh. The town clerk, who prosecuted on behalf of the Corporation, said that in one instance energy which should have been used for the charging of batteries for motor-cars was used by the firm for the artificial lighting of the premises, and when a superintendent called and took out the main power switch the effect was to extinguish all the lights in the place except one in the shop and those in the office. In the other case a small plug attached to the power main for demonstration purposes was being used to illuminate the shop window, and this also was wrong. Mr. Long (for defendants) said that defendants got a higher voltage than they required and were simply lowering it by putting in a line of lights.

Mr. Sidney said that the surplus light was no good for lighting purposes and was not employed as such. The lamps were used to facilitate the work of charging.

John Palmer, Junior & Co. v. County of London Engineering Works, Ltd.

GOVERNMENT SURPLUS MAGNETOS.

IN the Mayor's & City of London Court, on January 18th, before Judge Shewell Cooper, plaintiffs claimed against defendants for £65 12s. 10d., paid for 18 Dixie magnetos not according to contract, and which defendants agreed to take back. Mr. Beresford, for the plaintiffs, said that a customer of the plaintiffs in South Africa wanted some magnetos and instructed the plaintiffs to buy some Dixie magnetos which were American. Plaintiffs wrote to the defendants and said they had an order for new magnetos and asked for particulars, stating that the goods were for export. On December 12th defendants wrote and said they could supply magnetos from stock as required and on December 13th, they said the price would be £2 17s. 6d. net cash. The letter stated "all to be guaranteed new unused and in perfect order and condition. This is an essential condition of the order. Please be sure that these magnetos are securely packed so that they will arrive at destination in proper condition." Dixie magnetos were largely used during the war. They were originally in the hands of the Germans and this country was flooded with magnetos from America. On December 16th, defendants said they could supply 18 4-cylinder magnetos, and they said that they guaranteed them as being new Government surplus, unused and in perfect order and condition. The goods were dispatched to South Africa and on January 21st plaintiffs received a cable from their customer stating that the magnetos were imperfect, that they had been used, and that they were returning them unless an allowance of 40s. each was made. The plaintiffs were naturally surprised to receive such a telegram in view of the fact that the defendants had guaranteed them to be new Government surplus stock. Defendants said they could not understand the plaintiffs saying that the magnetos were not new, as they were Government surplus unused magnetos, and had only been standing in the stores, and when they left London each magneto was thoroughly tested and found to be in perfect condition. Defendants offered to allow a discount of 17s. 6d. per magneto, but that was not accepted. The South African people made a minute examination of the magnetos and in the end they were returned to this country. What the South African people com-

plained about was that there were damaged distributor blocks, that they were second-hand, and had worn platinum points, broken contact breaker springs, worn and second-hand distributor disks, broken and partly missing sparking gaps, protectors worn and missing distributor brushes. The South African people advised that the magnetos should be examined by a Commissioner for Oaths, and that was done. The magnetos were returned and the plaintiffs now demanded a return of their money. It was now suggested that the people in South Africa had damaged the goods.

After the case had been heard in some detail, Judge Shewell Cooper said he was against the defendants. They had assumed that the magnetos were new and unused because they were Government stock. He was quite satisfied that they were not new or unused. He thought an unfortunate mistake had been made either in the deal with the Government or in taking them from stock. Defendants thought they were new and unused. They thought they were better class than they were. Judgment for the plaintiffs, with costs. Mr. Struthers, for defendants, asked for leave to appeal. Judge Shewell Cooper refused, and said it was a pure question of fact.

Workmen's Compensation Claim.

Shot-firing Accident in a Scottish Mine.

In the Court of Session, Edinburgh, judgment has been given in a stated case on appeal against a decision by the Sheriff-Substitute in Dunfermline in an arbitration under the Workmen's Compensation Act, arising out of an accident in the Aitken Pit, Kelty, whereby the appellant, a miner, was injured.

The respondents, the Fife Coal Co., Ltd., maintained that the injury by accident did not arise out of and in course of his employment. The Sheriff-Substitute, upholding the respondents' contention, refused to award compensation, and the Court of Session now holds that there was evidence on which the Sheriff-Substitute was entitled to reach his decision.

The Lord President said the case arose out of a contravention of Section 2 (L) of the Explosives in Coal Mines Order, 1913. By that paragraph, where shots in a mine were fired electrically, this could only be done by a person who was authorised in writing; it was further specified that he himself was to be the person who coupled up the cable to the fuse wires. In the present case the duly authorised shot-firer handed to the appellant the cable by which he signified his desire that the appellant should do what it was his duty, and his duty alone to do, namely, to couple the cable to the fuse wire. The accident happened in connection with the actual firing of the charge, which took place very shortly afterwards, and, in particular, after the appellant had, in discharge of the duty which he understood the shot-firer had committed to him, brought together the cable and the fuse wire, and was actually in process of twisting them together. The whole and only question which the case raised was as to whether the present case was distinguishable from the case of Smith *v.* The Fife Coal Co., decided in the House of Lords in 1914. His Lordship held that the facts in the present case were not identical with those in the Smith case. In the present case the breach of the prohibition by the workman was in active progress at the time when the explosion took place, and, what was more, could not, in his Lordship's opinion, be regarded as anything else than one of the direct and immediate causes of the accident in question. In these circumstances it seemed to him that the learned arbitrator had arrived at the true result.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Power Transformers for 66,000 V.

With reference to Mr. W. T. Taylor's letter in your issue of January 12th, the following particulars of e.h.p. power transformers, which we have built or have at present on order, may interest him, and others of your readers:—

Newcastle.—

Six 4,000-kVA, single-phase, oil-immersed, forced-cooled transformers, working pressure 11,000/66,000 V, connected in delta/star for 12,000-kVA, three-phase groups.

Test pressure: 133,000 V for one minute between h.p. winding and l.p. winding, and between h.p. winding and frame.

(We have delivered six of these transformers and have at present a further six on order.)

Tasmanian Hydro-Electric Power Scheme.

Two 1,000-kVA, three-phase, oil-immersed, self-cooled transformers for outdoor sub-stations; working pressure 88,000/11,000 V star/delta connected. These transformers were tested with 220,000 V for one minute between h.p. winding and l.p. winding, and between h.p. winding and frame.

Mangahao, N.Z.

We have in hand the following transformers:—

Four 1,500-kVA single-phase, 110,000/11,000 V.

Five 1,500-kVA three-phase, 110,000/11,000 V, delta/star connected.

Test pressure: 220,000 V for one minute between h.p. windings and l.p. windings, and between h.p. windings and frame.

The above single-phase 110,000-V transformers correspond to Mr. Taylor's cases (*a*) and (*c*), and the three-phase transformers to cases (*b*) and (*d*).

In addition to the above we have recently built a 2,500-kVA single-phase, 11,000/132,000-V transformer, which was tested with 270,000 V for one minute between h.p. windings and l.p. windings, and between h.p. windings and frame. This transformer corresponds to Mr. Taylor's cases (*a*), (*c*) and (*e*), the h.p. winding being for 76,000 V across terminals and insulated for a 132,000-V (76,000 x $\sqrt{3}$), three-phase line.

All the above transformers are designed for the specified test pressure to be applied from a separate source between the whole of the h.p. windings and the l.p. windings and frame.

Metropolitan-Vickers Electrical Co., Ltd.

Manchester, *January 17th*, 1923.

Static Charge in Printing Machinery.

Whilst installing a system of electric control in a newspaper printing works I was asked by the proprietor if there was any method of nullifying the static charge on the paper, which causes it to cling to the rollers occasionally, causing stoppages.

Perhaps you or some of your readers may be aware of some method of discharging the paper, and be kind enough to communicate it to your "Correspondence" column.

January 18th, 1923. **Inquirer.**

London's Electricity Supply.

My letter to you of last week was not sent with the object of starting a correspondence or entering into a controversy on the subject, as from past experience I know that if any statement of the Invincible Press is queried they generally assert the privilege of the Crown in criminal trials and have the last word. I cannot, however, let your further remarks this week go unchallenged.

As regards your remarks that distributing systems will be the chief obstacle, from personal knowledge I can say that the existing distributing systems make it impossible, on account of expense, to carry out the change you desire.

I can speak from experience of having made some "change-overs," both from d.c. to a.c., and of increasing the pressure from 100 to 200 volts, and the expense of a small change-over is enough to enable me to say that such a vast alteration as you suggest is impossible.

The Electricity (Supply) Acts do not touch the retail side of the business, so that, in common with many others, you are expecting more from the Acts than is contained therein.

I quite agree with you that we want to insist upon something better, but this something better is useless unless the consumer benefits, and I have waited in vain to see it proved at any of the inquiries which have been held that as the result of what is proposed the consumer will be enabled to be supplied at a cheaper rate than hitherto. Efficiency of generation may be screwed up another point by some of the schemes, but when this gets watered-down through various channels to the consumer he will not find the decimal point has shifted in his favour—there is all the possibility of its shifting against him.

I also want to challenge the vain repetition of "cheap and abundant." I will only speak for myself, although I am quite certain my brother engineers will endorse my remarks as far as their own stations are concerned.

I challenge you to quote any single instance where, in the three towns at which I have been responsible for the management of the electricity undertakings, namely, Watford, Carlisle, and West Ham, there has been any lack in abundance of supply, or any application was ever turned down for the want of sufficient supply.

As to cheapness, my opinion has always been that in the past, in our anxiety to get business, we electrical engineers supplied current too cheaply, and did not have sufficient balance for development work, and here again I have not yet seen any figures put forward to show how the consumer will be supplied more cheaply in the future than in the past.

I consider it is quite time the clap-trap of "cheap and abundant" was dropped altogether.

I do not agree with you that because the ordinary consumer is sure to consider electricity in the same light as other commodities this is a reason for charging similar prices in adjacent districts.

The user of electricity always does, and always will, consider he is being exploited when he is charged three times as much for lighting as for power in the same district. As you say, he is not a student of cost, and never can understand, and I consider it is useless to try and argue. Unless you

make a clean sweep there must be a dissimilarity of prices in adjacent districts, and in fact I can go through a list of other commodities (and services) to which you make reference, and show that your argument is one which does not warrant serious attention.

To those of us who have studied this matter for many years, and have been hard up against all the details involved, it is quite clear that evolution, and not revolution, is the solution, and the dictionary tells us that evolution is a gradual process of growth. The trend of events seems to want to make it of such rapid growth as to make it revolution, and this is where I am in conflict with your leaderette and the many preposterous claims that have been made in other directions on this subject.

F. W. Purse,
Engineer and Manager.

Electricity Department,
County Boro' of West Ham.
January 16th, 1923.

The Sale of Wireless Apparatus.

Referring to your leading article on the above subject in your issue of the 19th inst., may I suggest that the Broadcasting Co. should arrange for contractors to give demonstrations during their business hours? In these days most showrooms are closed by 6 p.m., but if transmissions were given, say, for an hour every afternoon between 3 p.m. and 4 p.m., contractors *could* demonstrate, and I feel sure you would find they *would* do so.

C. Culmer Hodges, A.M.I.E.E.

Electricity Works, Dawlish,
January 22nd, 1923.

A Motor-car Starter Problem.

Referring to the letter in your current issue on this subject, the writer experienced similar trouble on a well-known make of self-starter, &c., about six months ago. It proved a baffling problem, as the trouble was intermittent when the dynamo was used on battery charging. As a motor it was quite in order. I finally located the trouble in a field coil connection. The field coil was wound with enamelled wire. To the end of the coil was sweated a length of flexible, in the approved spiral form. Unfortunately the person responsible for the sweating had overlooked the necessity of scraping the enamel off the wire. Hence, externally a good sweated job appeared to have been made. Actually a sweated sleeve was slipped on the enamelled wire of the field coil.

When this joint was made good, no further trouble was experienced. This was a brand-new set, the car having only been delivered ffom the makers a week or two.

Peekay.

January 21st, 1923.

An Electrochemical Phase Advancer.

I am much interested in the article appearing on page 119 of your issue of January 19th, concerning an electrochemical phase advancer. In 1920 and 1921 I spent a considerable amount of time on this same idea, namely, that of using the principle of the secondary battery for condenser purposes, and on various occasions since then I have referred to the possibility of this application. I found, in general, that for circuits of normal frequency and voltage the advantage that could be secured by a condenser of this form was comparatively small, but it did not occur to me that the lower frequency and voltage of the rotor of an induction motor on load would offer a field wherein these disadvantages would not be of so much importance. I think that Dr. Wall is to be congratulated upon the idea of applying an electrolytic condenser of this type to this particular problem, and still more upon the idea of increasing the capacity by varying the temperature—which I have never tried.

William Cramp.

Electrical Engineering Department,
The University, Birmingham,
January 22nd, 1923.

The Carelessness of Power Users.

In times like the present, when all possible economy in running a plant should be of the utmost importance, it is really surprising to notice the utter indifference of most power users as to whether machines they buy are efficient or not, the primary consideration apparently being the question of price.

It is a strange idiosyncrasy, considering that the same buyers would be very keen about the efficiency of their electric lamps, motor cars, or gas cookers.

I suppose such indifference is due to the fact that few realise what, say, 2 per cent. higher efficiency on the motor they use does really mean at the present cost of electric power. It is easily proved that such a small difference in efficiency means from 12 to 15 per cent. interest per annum on the initial cost of the machine.

For example, if you save 5 per cent. in purchasing an inferior machine having only 2 per cent. lower efficiency than a better one you will be saddled with an interest of 12/15 per cent. per annum for all the time you make use of it.

To such indifference I am sure we owe the existence of some very poor specimens of machines now in the market, having as bad an efficiency as 5 per cent. below the best commercial efficiency obtainable, and fitted with enormous wasteful fans to extract and dissipate the excessive heat generated in the windings; yet such machines will sell if they can show 5 per cent. saving on the initial cost.

N. Pensabene-Perez, M.I.E.E.

London, *January 16th*, 1923.

Arc Welding.

I have just read with interest Mr. W. Langdon-Davies's article in your issue of the 12th inst, from which I gather that Mr. Davies is not averse to correspondence strictly limited to a.c. arcs.

Referring to fig. 5, I submit that a sine voltage wave applied to an arc results in a depression of the maximum and a concavity as indicated in the lower diagram of fig. 5 by Mr.

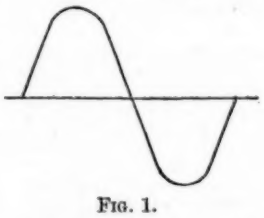


FIG. 1.

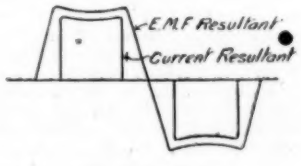


FIG. 2.

Davies; that an arc is not struck for an appreciable portion of the first half period, consequently a poor power factor results. But if there is no current, there can be no wattless current component, as shown in figs. 1 and 2 on the accompanying crude sketches, intentionally exaggerated.

W. E. Rogers.

London, *January 14th*, 1923.

I was keenly interested in the abstracts from Mr. J. Caldwell's paper on "Arc Welding," published in your issue of January 5th, and the "Notes on Arc Welding" by Mr. Langdon-Davies in your issue of the 12th, and note that both authors gave the impression that the covered electrode was superior to the bare electrode.

In practice I have found that the class of work to be welded is the factor which governs the type of electrode to be used.

If thin sheet metal or alloy steels are the materials to be welded, then covered electrodes are superior to the bare-wire electrodes. If, on the other hand, the work to be done consists of filling in cracks or blow-holes in large castings, joining mild steel plates, &c., then the bare electrode is far quicker, more economical, and generally superior to the covered electrode.

Thus it is misleading to generalise and say covered electrodes are superior to the bare electrodes or *vice versa*, when each is superior to the other in its own particular field of work.

J. F. Arnold.

Rugby, *January 15th*, 1923.

Report upon Railway Accident.—Reporting upon an accident which occurred at Retford, on the Great Northern Railway, on November 24th last, Major G. L. Hall states that although the system of signalling adopted appears to be adequate, "the advantages of a system which supplements by more or less automatic apparatus the safeguards prescribed by regulation are generally recognised. In cases of this kind, particularly where it is necessary for train-connecting purposes to bring two trains into one platform under all weather conditions, it is for consideration whether the most efficient signalling arrangement is not provided by a calling-on signal in combination with track-circuiting of the platform road; the occupation of the track circuit being designed, by selection or otherwise, to lock the running signal and to release the calling-on arm."

What Really Happened?—The *Daily Telegraph* describes an accident at the St. Pancras electricity works in the following curious manner:—

"St. Pancras was without electric light for an hour shortly after eight o'clock yesterday morning as a result of an accident at the electricity works. Through some defect the motor of a turbine became loose, and before anything could be done by the engineers it twisted round part of the turbine. It did not break loose, or much damage would have been done in the engine-shed. An engineer who was near by hurried up, and, shutting off the power, stopped the turbine. The service was restored in little over an hour."

BUSINESS NOTES.

The "Electrical Review" Index.—The Index to Vol. XCI of the ELECTRICAL REVIEW, which is now being printed, will be supplied only to those who specially apply for it through the post. To these it will be supplied for 6d. post free. Any reader or advertiser, at home or abroad, who requires a copy for binding, or for other purposes, is asked to make immediate application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C.4.

Bankruptcy Proceedings.—O. GREATHEAD AND W. GREATHEAD (Greathead Bros.), electrical engineers and contractors, 50, Burnley Road, Brierfield, Lancs.—Receiving order made January 13th on debtors' own petition.

H. J. W. EMBURY AND K. S. EMBURY (H. & K. Embury), electrical and mechanical engineers, 110 and 29, Queen Street, Newton Abbot.—According to the *London Gazette* of January 19th, the date of the public examination at the Castle, Exeter, has been altered to February 15th. Trustee, Mr. A. L. Honey, 23, Catherine Street, Exeter, appointed January 16th.

W. C. ELLIS, electrician, Applegate Street, Leicester.—Order for discharge made December 20th, subject to suspension for one day.

ARCHIBALD SMITH, who had traded as Smith & Gill, electrician, 57, Albion Street, Nelson.—At Burnley Bankruptcy Court, on January 18th, this case was mentioned. Debtor did not appear. The Official Receiver said debtor had written stating he intended leaving the country. He had come to the opinion that debtor had absconded, and he had applied for a warrant. The examination was adjourned *sine die*.

G. HILL, G. NOBLE & E. COWLEY (G. Hill & Co.), electrical engineers, 22, Chantry Lane, Great Grimsby.—First and final dividend of 5s. 5½d. in the £, payable January 30th, at the Official Receiver's office, Great Grimsby.

Company Liquidations.—GEORGE AIREY & CO. (ELECTRICIANS), LTD., 25, King Street, Sheffield.—In pursuance of the provisions of the Companies (Consolidation) Act, a meeting of the creditors of the above was held recently, at the offices of Messrs. Hancock & Ashford, 57, Surrey Street, Sheffield. Mr. J. Hancock, C.A., the liquidator in the voluntary liquidation of the company, submitted a statement of affairs, which showed liabilities of £393, made up as follows: Sundry creditors, £179; bankers, £13; and directors' salaries, £200. The claim of the bank was £56, but they held cash amounting to £43. The assets were estimated to realise £414, from which had to be deducted £29 for preferential claims, leaving net assets of £385, or a deficiency of £8. The assets consisted of plant, machinery, fixtures, fittings, &c., £75; office furniture, £17; sundry debtors, £76; cash in hand, £24; and stock in trade, £221. It was stated that voluntary liquidation had taken place owing to pressure by creditors. It was decided to confirm the voluntary liquidation of the company, with Mr. Hancock as liquidator.

ASSOCIATED ELECTRIC TRADERS, LTD.—First meeting of creditors and contributories February 1st, at Carey Street, W.C.

HARRIS ELECTRO METALS CO., LTD.—Winding up voluntarily. Liquidator: Mr. B. L. Peace, 27, Slaithwaite Road, Thornhill Lees, Dewsbury. Meeting of creditors January 31st, at 1, Northgate, Cleckheaton.

VULCO ACCESSORIES, LTD.—A meeting of members is called for February 27th, at 153, Moorgate, E.C., to hear an account of the winding-up from the liquidator, Mr. E. B. Turquand.

Dissolutions of Partnership.—DOMESTIC ELECTRIC TRADERS, electrical engineers, Cleveland Buildings, Market Street, Manchester.—Mr. E. Gill and Mr. E. Smith have dissolved partnership. Debts will be attended to by Mr. Smith, who will continue the business under the same style.

AUTOMOBILE ELECTRICAL EQUIPMENT AND REPAIRS, 64½, Villa Road, Handsworth, Birmingham.—Mr. A. H. Whitley and Mr. A. Lucas have dissolved partnership. Mr. Lucas will continue the business.

BROADWAY GARAGE, electrical and general engineers, motor engineers and agents, Broadway, Worcester.—Messrs. F. Blomfield, S. J. Adams and R. H. New have dissolved partnership. Debts will be attended to by Messrs. New and Adams.

GARTY & DANIEL, motor and electrical engineers, 16, Balham Hill, S.W.—Mr. J. B. Garty and Mr. R. Daniel have dissolved partnership. Mr. Garty will attend to debts and continue the business.

Trade Announcements.—MR. S. C. FRANKLIN has commenced business as a dealer in radio apparatus, electrical fittings, &c., at Westminster Buildings, 2, Westminster Drive, West Cliff, Southend-on-Sea.

MR. P. BAXTER, electrician, of Grantham, has removed his business from 29, Westgate, to more central premises at 70, London Road.

MR. V. G. BURKITT, of 53, St. Matthew's Road, Cotham, Bristol, is acting as agent for the Holland Cable Co. in Bristol and South-West counties, and is carrying stocks of cable, &c.

THE STERLING TELEPHONE AND ELECTRIC CO., LTD., has appointed Mr. V. Sinclair to take charge of its publicity department.

MR. FRANK THORP has been appointed London engineer to Messrs. Ferguson, Pailin, Ltd., 51, Norfolk Street, Strand, in succession to Mr. J. H. Sandiford.

MESSRS. HENDERSON & THORNTON, LTD., of 3, Percy Street, Tottenham Court Road, London, W, have recently purchased the entire stock of Messrs Harris & Russell, Ltd., and have taken over their part of the above premises. A catalogue and price list of electric light fittings, brackets, standards, &c., has been issued.

Catalogues and Lists. — MESSRS. BAIRD & TAILOCK (LONDON), LTD., 14-15, Cross Street, Hatton Garden, E.C.1.—Circular No. 126, containing descriptions, illustrations, and prices of electric furnaces of various types, accessories, &c.

THE SUN ELECTRICAL CO., LTD., 118 and 120, Charing Cross Road, W.C.2.—List No. 384, giving reduced prices of domestic electrical appliances. Also illustrated folders dealing with vacuum cleaners and electric washers.

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—Catalogue No. 970, giving numerous illustrations of lighting fittings of all types. Prices are given and there are two separate editions for home and export trade respectively.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburg (Pa.), U.S.A.—An illustrated description of De Laval transformer oil purifiers. Also descriptive leaflet dealing with "Type V A" a.c. switchboard panels.

STERLING TELEPHONE & ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W.1.—Publication No. 342, containing illustrated details of radio-telephony and telegraphy receiving sets, loud speakers, &c. Priced.

THE BOROUGH ENGINEERING & SUPPLIES CO., 31, High Street, Southampton.—A priced and illustrated pamphlet describing the "Terry" mechanical time switch-control.

GRAFTON ELECTRIC CO., 54, Grafton Street, Tottenham Court Road, W.1.—A comprehensive illustrated price list of small electrical equipment, including radio apparatus, cycle-lighting sets, instruments, accumulators, bells, hand lamps, lighting fittings, switches, &c.

MESSRS. ARNOLD & LARGE, LTD., 53, Broad Street, Birmingham.—A descriptive catalogue of presses for numerous purposes. Fully illustrated.

WATLIFF CO., 38, Webb's Road, Battersea, S.W.11.—A pamphlet dealing with the care and maintenance of commutators.

MARCONI'S WIRELESS TELEGRAPH CO., LTD., Marconi House, Strand, W.C.2—Pamphlets: L. 126/4, Marconi Aircraft Wireless Telephone, Combined Transmitter and Receiver (Type A.D. 2); L. 173/2, Three-kilowatt Continuous-wave Transmitter for Telegraphy; L. 199/2, Duplex Telephone Installations ("X" Series); L. 200/2, "Y" Series of Portable and Semi-portable Telephone-Telegraph Stations; L. 208, Marine-pattern Wireless Direction Finder (Type 11 B); and L. 209, Testing Set for Aircraft Wireless Apparatus.—All these publications are excellently illustrated..

MESSRS. A. H. HUNT, LTD., Tunstall Road, Croydon.—Catalogue No. 48, containing fully-illustrated details and prices of dry batteries, small switches, hand lamps, motor and cycle lighting sets, accumulators, and other electrical accessories.

MESSRS. MARRYAT & PLACE, 28, Hatton Garden, E.C.1.—An illustrated leaflet dealing with "Dependable" slow-speed geared motors, three-speed bench drills, &c. Priced.

CLEAR HOOTERS, LTD., "Hooterland," Highgate Square, Birmingham.—An illustrated and priced pamphlet advertising the "Owl" patent push button.

MESSRS. CROWTHER & OSBORN, LTD., 7, Blackfriars Street, Salford.—A folder containing prices of "Sceando" lamps of various types.

MESSRS. WM. SANDERS & CO., Falcon Electrical Works, Wednesbury.—An illustrated and priced pamphlet describing a new pattern of ironclad switch and fusegear.

MESSRS. DONOVAN & CO., 47, Cornwall Street, Birmingham.—Publication No. 1,123—a price list of electrical supplies, as lamps, lampholders, cables, switchgear, conduits, lighting fittings, &c.

Calendars.—MESSRS. ROYCE, LTD., of Trafford Park, Manchester, have issued a serviceable calendar for 1923, with bold black figuring on monthly sheets, each of which bears a half-tone view of their cranes, capstans, grabs, &c.

MESSRS. E. DAWSON & CO., of 10, Gray's Inn Road, London, W.C., have issued a wall card calendar with monthly slips.

Lost Time.—In a review of the stoppages in industry during the past year, the *Ministry of Labour Gazette* places the number of workpeople affected at 555,000, involving the loss of about 19,900,000 working days. Comparison with 1921 is of doubtful value, as during this year the dispute in the coal-mining industry occurred, affecting over a million workers, but the number of workpeople affected during 1921 is given as 1,829,000, and the lost time as approximately 86,000,000 working days.

Local Exhibitions.—During the New Year holidays an electrical exhibition was organised by the Electricity Department of the Burgh of Motherwell and Wishaw. Among the firms which participated in the display were the General Electric Co., Ltd., the British Thomson-Houston Co., Ltd., Messrs. Archibald Low and Son, the Meridian Electric Co., Messrs. Wood & Cairns, Ltd., Credenda Conduits, Ltd., the Metropolitan-Vickers Electrical Co., Ltd., Carron Co., Messrs. Williams & Colquhoun, the Singer Co., the Anglo-American Co., and others. A very representative display was the result. The radio side of the exhibition attracted a great deal of attention, demonstrations being arranged by a number of companies and the Hamilton Radio Society.

A successful electrical exhibition was recently organised by Messrs. Edwards & Armstrong, Ltd., at Cirencester, Glos. (one of their many branches), in co-operation with the local Electricity Supply Company. The exhibits covered a wide range, and included examples of up-to-date fittings and apparatus for lighting, heating, and cooking by electricity. Pumps and portable drills, &c., were in operation for the benefit of those principally interested in the adaptation of electricity to power purposes, while country visitors, dwelling out of reach of the town mains, were catered for by a Lister-Bruston automatic plant.

The second annual exhibition under the auspices of the Bradford Wireless Society was opened on January 25th, and continues until to-morrow at Belle Vue Barracks, Bradford, on a much larger scale than before. There are demonstrations by a dozen local and other firms, showing the latest in radio apparatus produced by British manufacturers. News and concerts are being provided by the British Broadcasting Co. A number of sets manufactured by amateur members of the society are also on view.

South African Tariff on Radio Apparatus.—*The British and South African Export Gazette* states that the Union Customs authorities have decided to place "Wireless telegraph apparatus and wireless broadcasting sets" under Class VI, carrying a general *ad valorem* rate of 20 per cent., subject to 3 per cent. rebate upon United Kingdom or Empire products.

Edinburgh Electrical Contractors.—The Edinburgh members of the Electrical Contractors' Association of Scotland have taken a group of eight stands at the forthcoming Ideal Homes Exhibition, which is to be held in the new Industrial Hall, Edinburgh, from January 31st to February 14th. A feature is being made of the Wireless Section and receiving apparatus by all the principal manufacturers will be shown. A special local broadcasting licence has been granted by the Postmaster-General for the period of the exhibition. An effort is being made to develop the domestic heating load, and constant cookery demonstrations will be given, and there will be a comprehensive selection of fittings and labour-saving appliances. The arrangements are in the hands of Messrs. D. S. Munro, W. Mackintosh, A. Pratt, A. J. Shand, and J. Plucknett. Concurrently with the exhibition, the contractors are conducting a publicity campaign in the local Press.

New Turbo-alternator for Lots Road.—We briefly mentioned in our last issue the placing of the contract for new plant for Lots Road power station. As the London Underground extensions are completed the electrical power equipment must also be extended, and in anticipation of the opening of the new lines now in course of construction, a contract has been placed for a 15,000-kW turbo-alternator for the power station at Lots Road, Chelsea. The turbine will be constructed by Messrs. C. A. Parsons & Co., Ltd., and the alternator by The Metropolitan-Vickers Electrical Co., Ltd. The cost will be £53,000, but this does not include the condensing plant, the contract for which has yet to be placed. At the same time other alterations are to be made at Chelsea to perfect the existing electrical plant. One of the improvements to be effected is the replacing of the cast-iron cylinders of the existing turbines with cylinders of steel, which will considerably increase their efficiency. The cost of these works will be £47,600, so that over £100,000 altogether is to be expended on necessary electrical equipment.

Book Notices.—"Who's Who in Engineering," edited by John Ed. Sears, C.B.E., &c. (pp. 1,211). London: The Compendium Publishing Co. Price 28s., plus postage in the United Kingdom, 1s. 3d.—The third edition of this useful work of reference shows a further increase in size, short biographies of over 8,000 engineers being now included. The information relating to engineering institutions, societies, and educational centres has been expanded by the inclusion of particulars of bodies of this nature throughout the British Dominions. In addition to this, the present edition contains a great amount of matter of general interest to engineers, as notes on current engineering topics, British Standard Specifications, and legal notes. Another useful section is the index, containing the names and addresses of manufacturers of engineering products. Other features are lists of manufacturers' associations and engineering journals.

"Radio Telephony for Amateurs," by S. Ballantine. Pp. 296; figs. 153. London: Chapman & Hall, Ltd. Price 7s. 6d. net.

"South African Mining and Engineering Journal Year Book," 1922-3. London: Argus South African Newspapers, Ltd. Price 10s. 6d.

We are informed by the Bureau International de L'Union Télégraphique, of Berne, Switzerland, that a new (8th) edition of the "Nomenclature Officielle de Stations Radiotélégraphique" (in French and English) has been published. Also the 3rd (Indian Ocean) and 4th (South Atlantic Ocean) sections of the official charts showing the situations of the radio stations of the world.

"Les Marées et leur Utilisation Industrielle." By E. Fichot. Pp. vi+256; illustrated. Paris: Gauthier-Villars et Cie. Price 9 fr.

"Dictionary of Applied Physics," edited by Sir R. Glazebrook. Vol. III—Meteorology, Metrology, and Measuring Apparatus. Pp. viii+839; illustrated. London: Macmillan and Co., Ltd. Price 63s. net.

"Text-book on Wireless Telegraphy." Vol. II.—Valves and Valve Apparatus, by R. Stanley. Second edition. Pp. xi+394; 249 figs. London: Longmans, Green & Co. Price 15s. net.

"Letters of a Radio Engineer to His Son," by J. Mills. Pp. vi+265; figs. 136. London: Geo. Routledge & Sons, Ltd. Price 10s. 6d. net.

Social Events.—At the invitation of Mr. Robson, of Messrs. Robson & Coleman, Electricity House, Haymarket, Newcastle-on-Tyne, the staff and employés, with their wives, held their annual social evening on Friday, January 19th, at the Minories Assembly Rooms. The company present numbered 130. Whist was played from 7 p.m. to 9.30 p.m., after which supper was served. During the interval Mrs. Robson presented the prizes to the successful players, and Mr. Robson also presented prizes to the students who had obtained the best results in the Evening Technical Classes. After supper, dancing and a second whist drive were indulged in until 1 a.m. Mrs. Lowrey presented the prizes for the second whist party. A vote of thanks to Mr. and Mrs. Robson was carried with musical honours.

At Leven, Fifeshire, Messrs. Moncrieff's electrical engineering staff held their annual dance, when those present had an opportunity of hearing an opera that was being broadcasted from London.

Exports and Imports of Electrical Goods for December, 1922.—The official returns of electrical exports and imports for December show, as regards the exports, a falling off in values of approximately £40,000 as compared with November, but in comparing the figures allowance should be made for the Christmas holidays. The total value of electrical exports for the month was £901,309, as compared with £944,074 for November, the principal decreases occurring in electrical goods and apparatus (£20,000 decrease) and telegraph and telephone instruments and apparatus (£70,000 decrease). The values recorded for nearly all the other items were well maintained, and in some sections increased, the electrical machinery export section showing an increase of £27,000.

The total weight of electrical machinery exports for the month was 1,608 tons, as compared with 1,196 tons in December, 1921, and 1,333 tons in December, 1920.

The electrical imports for the month totalled £262,634 as compared with £250,182 for the previous month, an increase of £12,000. Increased values are recorded in all sections with the exception of electrical machinery and telegraph and telephone instruments and apparatus.

Electrical re-exports at £16,647 are £4,000 in excess of the November totals.

VALUES OF ELECTRICAL EXPORTS AND IMPORTS FOR DECEMBER, 1922.

	Exports.	Imports.	Re-exports.
	£	£	£
Electrical goods and apparatus	101,222	72,547	3,552
Insulated wires and cables ...	186,145	26,337	45
Glow lamps	21,746	40,239	480
Arc lamps and parts	390	822	—
Batteries and accumulators ...	40,509	16,788	175
Meters and instruments	30,591	6,732	279
Carbons	1,106	8,603	244
Electrical Machinery.—			
Railway and tramway motors ...	28,256	—	—
Other motors and generators...	136,419	—	—
Switchboards (not telegraph or telephone)	7,602	255	—
Electrical machinery, unenumerated	162,274	58,076	9,785
Telegraph and telephone cable and material.—			
Telegraph and telephone wires and cable (not submarine) ...	35,638	7,025	—
Submarine telegraph and telephone cable	63,596	—	—
Telegraph and telephone instruments and apparatus ...	85,815	25,210	2,087
Totals	£901,309	£262,634	£16,647

Catalogues Wanted in China.—Mr. E. H. Berry, 3a, Wongkashaw Gardens, Shanghai, N. China, consulting electrical engineer, wishes to receive electrical, &c., trade literature, especially referring to cheap or fairly cheap new electrical goods and novelties that might appeal to the Chinese mind. Mr. Berry, in a letter to us, says:—"Anything new takes on, especially with electrical apparatus. Samples, where possible, would be useful."

A Well-tried Vacuum Cleaner.—A fire which occurred in the stores at the Ponders End works of the Edison Swan Electric Co., Ltd., some little time ago served, in a measure, to accentuate the robust qualities of the "Little Glutton" vacuum cleaner, which is manufactured by the company. Several of these machines were stored in the building which was completely destroyed by the fire. One of the vacuum cleaners was subjected to sufficient heat to melt some of the metal parts, and to badly distort others, and was also saturated by water. On its being placed on circuit it was found that the motor was in quite good running order, and the suction, as recorded on the water-gauge, had only decreased by half an inch from that originally recorded when the machine was new.

Russian Notes.—A Russian journal says that important successes have been achieved in the production of insulators for pressures up to 40,000 V, and the production of "Yulet" insulators has been begun at the Isolyator and Slavyansk factories. The Russian cable factory in Moscow is to be enlarged and machinery added.

The organising work for the formation of an All-Russian company for financing local electrical concerns is completed. The necessary capital has been subscribed, and 10,000 shares, making a sum of 500,000 gold roubles, have been allotted to the Glavelectro, a number of co-operative concerns, &c.

The Presidium of the Government Planning Authority has approved the statement of the year's credit requirements for electrical construction in Russia, for the working year 1922-23, namely, 3,919,000 gold roubles for the purchase of the necessary materials and machinery abroad, and 5,134,000,000 paper roubles (1922 standard rouble) for similar and other expenditure in Russia.

In connection with the general plan for the electrification of Azerbaidzhan, the following work has been completed by the Electrical Construction Department:—The reconstruction of the hydro-electric station in Kuba, where the building has been repaired and the equipment of the steam-driven power station has been put in order, and the work of illuminating the towns of Schusha and Agdasha has been begun. Besides this, the installation of the Kuba electric station has been completed, along with the town electric lighting system. The defects in the power station and lighting systems in the town of Gandzhe and other towns have been remedied. Projects for the construction of power stations in Schusha and Agdasha and the installation of a lighting system and electro-mechanical workshops in Agdasha have been prepared. Private projects in Schusha and Agdasha are held up for want of funds. A series of small local stations is in contemplation.

Trade With Czecho-Slovakia.—At the London Chamber of Commerce on Wednesday Lt.-Col. Sir Samuel J. G. Hoare, Bart., C.M.G., M.A., M.P., Secretary of State for Air, delivered an address on "Czecho-Slovakia as a Geographical Centre of European Trade." Dr. V. Mastny, Minister Plenipotentiary for Czecho-Slovakia in London, was present. A proposal was to be submitted for the formation of a Czecho-Slovakian section of the Chamber.

A Works Visit.—On January 18th the Duke of York paid a visit to the works of the London Electric Wire Co. & Smiths, Ltd., Leyton, accompanied by the director of the Industrial Welfare Society, Mr. Robert R. Hyde. He inspected the various departments and expressed his satisfaction and interest in what he saw.

Electricians' Wage Reduction.—Electrical trade workers in South Wales have accepted a reduction of 5s. for skilled and 3s. for unskilled workers per week from February 1st.—*Financier.*

New French Companies.—There has been formed at Thouars (Avenue de la Gare) the Energie Electrique de Charentes, with the object of distributing energy in the province of Anjou. The capital is fixed at 200,000 fr.

Comptoir Industriel Electro-Mécanique is the style of a company established for the manufacture and sale of electrical apparatus. The capital is 850,000 fr., and the offices are at Toulouse, 59, Rue Raymond IV.

There has been embodied at Gradignan (Gironde) the Société Radiolaire for the manufacture and sale of heating and other apparatus. The capital is 150,000 fr. in 500-fr. shares.

Electrical Developments in North Africa.—A new company has recently been formed in Bordeaux (42, Allées d'Orleans), with a capital of 1,500,000 fr. and the title La Compagnie Africaine d'Electricité, to establish electric lighting and industrial plants in North Africa.

Manufacture of Telegraph Apparatus in Bulgaria.—It is reported from Sofia that a concession has been granted to a company for the establishment of a factory for telegraph apparatus in that city. The share capital amounts to 5,000,000 leva, one half of which has been provided by the State and the other half by the Czecho-Slovakian company "Telegraphie," of Prague.

New German Coal Loans.—A Bill has been laid before the Diet of Saxony to authorise the Ministry of Finance to raise one or several loans of up to 3,000,000,000 marks for the extension of the Saxony State coal mines and electricity works. The Bill proposes to leave it to the Ministry to determine the State liabilities in the bonds not in marks or a foreign currency, but to draw these bonds in material values, possibly in coal. It is stated that the Government power station at Hirschfeld, based upon local coal, has gradually been developed to 85,500 kW. It is proposed to erect a second power station at Bohlen, where coal will also be used, and this station and that at Hirschfelde and the Reich power station at Lauta will have a total capacity of 160,000 kW and be able annually to produce 700,000,000 kWh.

British Municipal Contracts: An Appeal to the Government.—The following is a copy of a communication that has this week been addressed to Mr. Bonar Law by the Federation of British Industries:—"The Grand Council of the Federation of British Industries at their meeting held on Wednesday, the 17th instant, unanimously decided to urge upon H.M. Government the importance of placing public contracts, both national and municipal, in the United Kingdom.

"The arguments in favour of such a course on general social and patriotic grounds in the present industrial condition of the country are obvious. The placing of such contracts in this country would, unlike most of the schemes for the relief of unemployment, provide work for the skilled craftsmen, whose continued employment is so vitally necessary to the efficiency of industry, as well as for the unskilled worker, and by refusing to sanction loans or expenditure unless British plant and materials were specified, the Government would be taking a definite step to relieve general unemployment.

"The Federation have hitherto hesitated to press for such action, owing to the possibility of large divergencies in price or of difficulty in obtaining sufficiently prompt delivery. British industry can now, however, give earlier and more certain delivery than the majority of foreign manufacturers, while the differences in price have become substantially less, where they have not altogether disappeared.

"The Federation are well aware that public authorities may urge that they are custodians of public funds and thus bound, other things being equal, to expend those funds in the cheapest markets. In the case of municipal works, financed by loan, the burden on the rates caused by the necessity of raising the additional (and relatively small) sum required to cover any difference in price, is negligible, as it can be covered by a sinking fund payment spread over a period of years, and now that British prices are comparable with even the lowest foreign prices, this argument has lost much of its force.

"Even where foreign prices are still lower than British, the Federation are of opinion that the following considerations should be taken into serious account.

"In the first place, the continued placing of orders abroad by British public authorities has a very serious effect upon the prestige of British industry, and this effect is not confined to the country in which the order is placed since the foreign manufacturer takes advantage throughout the world of the advertisement thus given to him. There is very little doubt that persistence in such a course would lead to the loss of many valuable foreign contracts which would otherwise have been secured by British firms.

"In present circumstances the expenditure of public funds abroad means, in fact, the direct importation of labour into a country where there is already a serious state of under-employment. The public authority, therefore, which places contracts abroad is paying double labour costs on the materials purchased, since there is the labour cost abroad represented in the price of the materials and a second labour cost at home in the form of relief for the unemployed in this country. It is true that an individual local authority may believe that by placing an order in another part of the country they are not helping to solve their own problem of unemployment. As, however, from 50 to 80 per cent. of the cost of the materials, plant, &c., would rapidly be put into circulation in the form of wages, thus creating a demand for commodities which will react on unemployment throughout the country, even this somewhat narrow argument loses much of its weight.

"The Federation also consider that in adjudging this question some importance should be attached to the abnormal circumstances of the present time and in particular to such matters as the temporary advantage in competition conferred upon some foreign manufacturers by depreciated exchanges.

"The Federation therefore hope that the Government will adopt the definite principle that in all contracts financed by public funds, the plant and materials specified must be British, and will issue instructions to the departments concerned that no sanction should be given to expenditure or to the raising of loans by public authorities for such expenditure without the insertion of such a provision.

(Signed) "ERIC GEDDES,
"President."

German-Russian Trade.—It is stated that the Russo-German Electro-Union Co. has been constituted in Berlin for the promotion of trade with Russia and the border States. The promoters are the Halkethal Wire Co., the Paul Meyer Co., the Lorenz Electrical Co., and the Lloyd Dynamo Works Co.

For Sale.—The London & North-Eastern Railway invites offers for surplus electrical machinery, including generating sets, condensing plant, boilers, feed pumps, &c.

Messrs. Furber & Maskell are inviting offers for the purchase of the assets of the Malden Engineering & Aircraft Equipment Co., Ltd.

Stoke-on-Trent electricity department has for disposal one 300-kW single-phase alternator, direct coupled to a McLaren compound vertical engine, with exciter, two circulating pumps and two air pumps. (See our advertisement pages to-day.)

Bribery.—The Prevention of Corruption Acts make it a criminal offence, the penalties being very heavy, to offer or give an employé any secret commission or discount or other gift; or for an employé to ask for or accept anything of the kind. The misuse of documents—false receipts, double tenders, or invoices, &c.—is also prohibited. All who value honest service and clean trading are asked to co-operate with the Bribery and Secret Commissions Prevention League, Incorporated, which gives free advice and assists in enforcing the observance of the law. All communications are treated as confidential by the secretary, 9, Queen Street Place, London, E.C.4.

Rubber Research.—At a meeting of the Institution of Rubber Industry, held at Manchester on Monday last, Mr. B. D. Porritt, director of the Research Association of British Rubber and Tyre Manufacturers, read a paper on the scope and progress of the Research Association.

Kathanode Batteries.—THE D. P. BATTERY CO., LTD., has received a repeat order (placed without competition) from Messrs. Weston & Westall, for one of its "Kathanode" traction batteries. In both cases the batteries are for Garrett 2-ton vehicles.

B.E.D.A. Annual Meeting.—The third annual general meeting of the British Electrical Development Association, Incorporated, will be held at the Hotel Cecil, W.C.2, on Friday, March 16th, at 12 noon, and will be followed by the annual luncheon of the Association at 1 p.m.

LIGHTING AND POWER NOTES.

Aberdeen.—PLANT EXTENSIONS.—The Corporation on January 15th approved a recommendation by the Electricity Committee for extensions to the engine room and switch chamber at the Ferryhill electricity works at an estimated cost of £8,593.

Australia.—NEW SOUTH WALES.—The Dorrigo hydro-electric scheme has recently been completed and put into operation. The scheme consists of a weir across Bielsdown Creek, about a mile above Dangar Falls. The water is carried to the power station, situated on the bank of the creek 230 ft. below. Two turbo-generators are installed, each of 100-kW capacity. The generators supply current at 2,300 V, which is transmitted over two miles to the town of Dorrigo, and there transformed for lighting the town and supplying the butter factory and town with power.

VICTORIA.—The Victorian House of Assembly has adopted a Bill providing for the raising of £1,576,000, to be spent on the works of the State Electricity Commission. Included in the sum is £760,000 for additions to the main scheme, power house, &c., at Yallourn (Morwell), £120,000 on extensions of the transmission line to the south-west of the State, £50,000 for the Sugarloaf hydro-electric scheme, and £70,000 for an electricity scheme in Gippsland, beyond Morwell.—*Reuter's Trade Service* (Melbourne).

WINDSOR (QUEENSLAND).—The Town Council has under consideration a proposal to obtain a bulk supply of electricity from the City Electric Light Co. A loan of £25,000 has been promised to carry out the scheme.

CASINO (N.S.W.).—The Town Council has adopted a temporary scheme for lighting the town by electricity. The Chief Engineer of the Public Works Department has suggested a hydro-electric scheme utilising the Richmond River.

CLARENCE RIVER (N.S.W.).—Steps are being taken by the County Council to raise a loan of £100,000 in connection with the proposed Nymboida hydro-electric scheme.

Barrow.—BREAKDOWN.—A breakdown occurred at the electricity works on January 18th due to a mouse which found its way on to an oil switch. A short-circuit resulted, and the town was in darkness for over half an hour.

Basingstoke.—LOAN.—The Town Council has applied to the Electricity Commissioners for a loan of £1,734 to meet the cost of the extension of the mains to Sherborne St. John.

Bedford.—SPECIAL ORDER.—The Rushden and District Electric Supply Co., Ltd., is applying for a Special Order to extend its area of supply so as to include certain parishes in the North and North-west of Bedfordshire, and a boundary line between the proposed areas of supply of the Bedford Corporation and the company has been agreed provisionally. Negotiations are proceeding for the supply of electricity in bulk to Biggleswade Urban Council, and the Bedford Town Council has included in its area 36 parishes, in respect of which a Special Order is being applied for.

Bexhill.—NEW POWER STATION.—The Town Council has acquired a site at Little Common for the erection of an additional generating station.

Bradford.—ELECTRICITY SUPPLY.—The Corporation Unemployment Sub-Committee and the local Board of Guardians have under consideration further schemes for providing work for the unemployed, including the laying of new mains at an estimated expenditure of £49,000, subject to Government grants being obtained up to 80 per cent. of the amount paid in wages

Bradford-on-Avon.—ELECTRICITY SUPPLY.—The Rural Council has decided to support the application of the Western Electric Distributing Corporation, Ltd., for powers to supply electricity to parishes in the area of the Council. The Corporation proposes to obtain electricity in bulk from Bath.

China.—HYDRO-ELECTRIC DEVELOPMENT.—According to the bulletin of the Bureau of Economic Information, the Foochow Electricity Co. is making estimates for the erection of a hydro-electric plant at the waterfalls between Shihping and Lungting, in the Kutien district.—*Reuter's Trade Service* (Shanghai).

Continental.—FRANCE.—Application has been made by the Société Agricole d'Electricité de Ray-Cendrecourt to set up two 10,000-V transmission lines to serve a number of communes in the Haute Marne and Haute Saône departments.

The company La Régionale Electrique, of Lyons, has applied for sanction to set up a distribution network to serve 16 communes in the department of the Isère.

The Ministry of Public Works is studying the formation of a hydro-electric group in the St. Etienne and Grenoble region, embracing five electrical companies and the Firminy Ironworks, with the title of Société pour le Transportation de l'Energie du Centre, with a view to obviating the difficulties experienced by the various trusts from the lack of power during the recent drought. Four transmission lines are projected, two of which will be for 3-phase, 50 periods, 120,000 or 150,000 V, to be completed in four years; and the other two in ten years.

The departmental authorities of Bouches-du-Rhône have applied for a concession for the erection of two hydro-electric stations at Meyrargues and Saint Christophe. The former, on the Durance River, is to be completed first. 15,000 kW will be reserved for the Minister of Agriculture for the irrigation of the Crau, the Camargue, and elsewhere. The cost of the two stations is estimated at 140,000,000 fr. The transmission lines to Marseilles and Lamanon will cost a further 10,000,000 fr. The total power of the two stations, linked with secondary stations, including an auxiliary station at Marseilles, will be 63,000 kW.

The Board of the Energie Electrique du Nord has decided to take in hand at once the second stage of the construction of its new generating station at Comines. It is intended to install additional plant of 35,000 h.p., which will bring the total capacity of the station to 150,000 h.p.

CZECHO-SLOVAKIA.—PRAGUE.—A company has been formed, with the help of the State and the province of Bohemia, which will provide the town with the electricity. This company, which has a capital of 180,000,000 crowns, has been formed at Ervenice under the style of the Central Electricity Works. The works will be erected near the Edwige lignite field at Ervenice not far from Most (North-West Bohemia). Its initial output will amount to 45,000 kW. The current will be transmitted to Prague at a pressure of 100,000 V. Preparatory operations in connection with the building of the works, which will be the largest in Czecho-Slovakia, have already been commenced.—*Reuter's Trade Service* (Prague).

Cwmamman.—ELECTRICITY SUPPLY.—The Urban Council has instructed the clerk to write to the Swansea Corporation asking the Corporation if it would be prepared to light the district by electricity and on what terms.

Formby.—ELECTRICITY SUPPLY.—Arrangements have been completed under which the London & North-Western Railway Co. will supply electricity for private and public purposes in Formby and Hightown. In the latter case the Little Crosby Urban District Council has the right to take over the undertaking on giving six months' notice.

Glasgow.—NEW SUB-STATIONS.—The Electricity Committee has recommended the purchase of a site in Langside for a sub-station. It is also recommended that an additional sub-station be built in the central district of the city, and that a site in Virginia Street be purchased for that purpose.

Grampians.—HYDRO-ELECTRIC SCHEME.—The *Evening News* stated on January 9th that the necessary capital for the carrying out of the Grampians hydro-electric scheme had been raised, and that it was proposed to commence operations at an early date.

Hastings.—LOAN.—The Corporation has applied to the Electricity Commissioners for sanction to the borrowing of £10,000 for services and £1,000 for meters. Rye Town Council, which is applying for powers to supply electricity to the borough, has applied to the Corporation for the advice of the borough electrical engineer (Mr. Ferguson) upon the negotiations. The matter has been referred to the Electricity Committee for a report.

Irish Free State.—WICKLOW.—At an inquiry into the Wicklow Urban Council's application for an Electric Lighting Order, the representative of the Free State Department of Commerce said it was intended that in future all such municipal undertakings in the Free State area would be governed from Dublin.

DUBLIN.—*Cables Cut.*—On January 16th the cables forming a number of arc-lamp circuits on the north side of the city were cut, and several streets were deprived of light. Over a hundred lamps were affected, but the damage was repaired on the following day.

Littleborough.—ELECTRICITY IN BULK.—The Urban District Council has referred to its consulting electrical engineer for consideration and report revised terms submitted by the Rochdale Corporation for supplying electricity in bulk.

Liverpool.—EXTENSION OF AREA.—The Order made by the Electricity Commissioners extending the Corporation's area of supply to include Bootle, Litherland, Waterloo-with-Seaforth, and Great Crosby has been confirmed by the Minister of Transport.

London.—PRICE REDUCTIONS.—The St. James' and Pall Mall Electric Light Co., Ltd., has reduced the prices of energy as from the December meter readings. The new schedule is as follows:—Lighting, first 4,000 kWh per annum, 6d. per kWh, beyond 4,000, 4½d. per kWh (minimum 10s. per quarter); power, 1½d. per kWh, with a fixed charge of 9s. per rated h.p. per quarter; and heating, 1½d. per kWh.

Nottingham.—ELECTRICITY ORDER.—The Town Council has applied for authority to extend the electricity mains to several parishes outside the city.

Rampside.—INAUGURATION OF ELECTRICITY SUPPLY.—A supply of electricity for private purposes was inaugurated last week. Electricity is obtained from the Barrow-in-Furness Corporation.

Rochdale.—EXTENSION OF SUPPLY.—The Electricity Commissioners have sanctioned the supply of electricity by the Corporation to Milnrow. The cables have been laid to Firgrove, and when these and the sub-station are completed, the supply will be available.

South Africa.—JOHANNESBURG.—The Town Council has "received," by a majority of one, a report prepared by the Electricity Committee upon the advisability of a temporary bulk supply from the Victoria Falls Power Co. to meet the pressing demand for electricity. It is estimated by Mr. Sankey (the electrical engineer) that it will take five years to erect the buildings and install the necessary plant to meet future requirements, and the Power Co. has offered to supply energy at a flat rate of ¾d. per kWh for that period. As the feeling of the Council is so evenly divided, it is doubtful if the scheme will be proceeded with.

Southampton.—PRICE REDUCTIONS.—The Electricity Committee has recommended the following reductions in the charges for electricity:—Lighting, from 6d. to 5d. per kWh; and heating and cooking, from 1½d. to 1¼d. per kWh for the summer quarters.

ELECTRICITY ORDER.—The Electricity Committee has also recommended that application be made to the Electricity Commissioners for an Order authorising the Borough Council to supply electricity in the district of South Stoneham.

Stoke-on-Trent.—ELECTRICITY EXTENSIONS.—Important extensions to the electricity undertaking were formally opened on January 18th.

Ticehurst.—ELECTRICITY SUPPLY.—The Rural Council has referred to the Clerk a proposal from the Parish Council that electricity should be obtained from the Tunbridge Wells Corporation for Frant, Wadhurst, and Ticehurst. It is proposed that a company should be formed to obtain electricity from Tunbridge Wells, and that the Council should guarantee a portion of the capital.

Truro.—ELECTRICITY SUPPLY.—The Town Council, on January 17th, approved of an electric lighting scheme to be carried out by the Cornwall Electric Power Co.

Ware.—ELECTRICITY CHARGES.—The North Metropolitan Electric Power Supply Co. has applied to the Electricity Commissioners for an Order altering the maximum charges for electricity to a flat rate of 10d. per kWh for lighting, or, for the equivalent of the first 100 hours' use per quarter of the maximum demand, 1s. per kWh and 4d. beyond. For lighting and heating metered together, a fixed charge of £24 per kW per annum, and 1½d. per kWh for electricity used, with minimum payments of 12s. 6d. for each winter quarter, and 8s. 4d. for each summer quarter. For power, a flat rate of 4d. or £1 per kVA of the maximum demand per quarter, and 1d. per kWh for all electricity metered, subject to an advance of 50 per cent.

Watford.—EXTENSION OF AREA.—The Minister of Transport has confirmed an Order made by the Electricity Commissioners extending the Urban District Council's area of supply to include Hemel Hempsted, King's Langley, and Bovingdon.

TRAMWAY AND RAILWAY NOTES.

Australia.—MELBOURNE.—The Victorian Minister of Public Works is considering a proposal submitted by the Melbourne Tramways Board for the development of the tramway system in the metropolis. It is proposed to abandon a number of existing tramway routes and to lay 53 new routes. The scheme is estimated to meet requirements until 1940.

Continental.—SWITZERLAND.—With a view to relieving the great amount of unemployment in the Swiss machine and electrical industries, the general management of the Federal Railways is about to lay a proposal before Parliament for the acceleration of the electrification of the railways. According to the new programme, from 75 to 80 million francs will be laid out annually instead of 50,000,000 as hitherto.—*Reuter's Trade Service* (Zurich).

India.—SINGAPORE.—An advance party of the Shanghai Tramway Co. has arrived in connection with the taking over of the Singapore system by that body. It is understood that railless traction is to be the future system.—*Reuter's Trade Service* (Singapore).

London.—NORTH LONDON.—The London, Midland & Scottish Railway Co. has informed the Hackney Borough Council that it has no immediate intention of electrifying the North London Railway from Broad Street to Poplar, but that the question will not be lost sight of.

Newcastle.—LOAN.—The Transport and Electricity Committee has recommended that application be made to the Ministry of Transport for sanction to the borrowing of £179,558 in respect of past and prospective tramway work, including the North Road improvement scheme.

Southampton.—NEW ROUTE.—The Tramways Committee has recommended that application be made to the Ministry of Transport for sanction to construct a double track on the proposed extension of the route to Bitterne Park and to carry out the scheme as soon as the laying of the Avenue and Hampton Park tracks is completed. The Ministry of Transport has already approved of the laying of a single track.

West Hartlepool.—RAILLESS CAR SYSTEM.—At a recent meeting of the Town Council, the chairman of the Tramways Committee stated that the estimated cost of substituting railless cars for the present system was £9,000, but the committee had found that by using its own labour, the cost would be reduced. Application has been made to the Ministry of Transport for a Provisional Order to carry out the scheme. It was pointed out that it would cost £40,000 to relay the track.

Yarmouth.—TRACK RENEWALS.—The Tramways Committee has recommended the Town Council to renew certain portions of the tramway track at an estimated cost of £60,000. The Council has decided to obtain the advice of its consulting engineer before proceeding with the scheme.

TELEGRAPH & TELEPHONE NOTES.

China.—SHANGHAI.—Commercial wireless communication between the United States and China has now been established. The Federal Telegraph Co. announced on January 5th that a station at Hillsboro, Oregon, working on 8,400 metres, was being heard regularly at Shanghai, where the company had erected an experimental station.—*Reuter* (San Francisco).

An American company intends shortly to inaugurate a radio-telephone broadcasting service in Shanghai.—*Reuter* (Shanghai).

France.—RADIO COMMUNICATION.—Direct communication has just been set up between France and Poland. Since December 5th direct communication has been established between stations at Paris and Beyrout, served respectively by the Radio France and Radio-Orient companies. Urgent telegrams are received at triple tax, and deferred and Press telegrams at half tariff.

TELESTEREOGRAPHY.—It is announced that further experiments are to be made by the French telegraph and telephone service in connection with the transmission by wire or radio of photographs, drawings, finger-prints, and handwriting by the system invented by Dr. Belin, known as telestereography. It is hoped that the system may prove of particular use in communicating with Eastern countries, such as Japan and China, where it would be of advantage to transmit the native characters instead of having to translate them into a Western alphabet.—*Reuter.*

International Telephony.—FRENCH CONFERENCE.—Representatives of the Western nations of Europe are being invited by the French Government to take part in a departmental conference to consider the linking-up of Europe by telephone. The plan involves communication between England, France, Belgium, Switzerland, Italy, Spain, and Portugal. The Conference will deal with the preliminary questions regarding the

class of conductors to be used, the amount of underground cable and open wire that will be needed, the traffic to be carried, and the number of circuits, the location of "repeater" stations, and, in fact, all the technical details which it is necessary to settle in preparation for an administrative conference, at which all the points of international policy and the methods of handling the system in an international sense can be developed and agreed upon.—*Morning Post.*

Italy.—NEW CABLE.—According to the *Elettricistà*, the Italian Chamber of Commerce in New York has been asked to lend its moral and financial support to the organisation of a company to lay a telegraphic cable from the Azores to Italy and of a direct cable service from Italy to the United States.

Kenya Colony.—RADIO-TELEGRAPHY.—In connection with the project whereunder the Marconi Co. is to erect a long-range radio station in the Union of South Africa, the *British South African Export Gazette* says that public feeling in Kenya Colony is greatly perturbed at the prospect of being omitted from the scheme, and so great is the pressure being brought to bear that its re-inclusion seems highly probable. In South-West Africa tenders have already been obtained for the erection of radio station buildings at Walfish Bay. From Capetown to Nairobi, in fact, radio holds the popular attention, and active markets are developing or in prospect not only for large station equipment, but for small receiving sets and apparatus for private users.

Norway.—COMMUNICATION WITH AMERICA.—As a result of the installation of a new valve transmitter, the wireless station at Bergen has repeatedly been in communication with American stations, whose signals have been distinctly heard. The Bergen station has also been equally successful in transmitting replies, the American stations reporting that the signals were very distinct.—*Reuter* (Christiania).

Radio-Telephony.—GLASGOW BROADCASTING STATION.—The Glasgow Corporation Electricity Committee had before it on January 18th an application by the British Broadcasting Co., Ltd., for permission to install broadcasting apparatus at the Port Dundas generating station. The application was remitted to a sub-committee for consideration and report.

BROADCASTING LICENCES.—With the coming of "frame" aerials the practice has grown among enthusiasts of taking their receiving instruments with them to parties at the houses of friends. The General Post Office having heard of this practice has decided that it is not permissible. A broadcast licence is issued in respect of a definite address, and must be used only at that address. Movement is permitted to agents of wireless firms, *bonâ fide* lecturers and demonstrators, and a few others. These are known as "pedlar's" licences, and the issue is limited. Even if a holder changes his postal address he must go to the Post Office and have the address altered on his licence.

Radio-Telegraphy. — JOURNALISTIC ENTERPRISE. — On and after February 10th an Atlantic edition of the *Daily Mail* will be printed and published on board the Cunard Co.'s liners sailing between Southampton or Liverpool and New York and other North Atlantic ports. News from the U.S.A. and Great Britain will be conveyed by a special radio service.

Switzerland.—RADIO-TELEGRAPHY.—A convention has been arranged between the German and the Swiss Governments whereby all the Swiss networks may now communicate with all the networks of Bavaria and Wurtemberg, also with those of the postal districts of Darmstadt, Frankfort-on-Main, Karlsruhe (Baden), and Constance. It is announced also that, by an agreement between the Governments of France and Switzerland, all the Swiss networks may now exchange messages with all the networks in the Department of the Upper Rhine. The tax for a non-urgent conversation within a distance of 30 kilometres is 1 fr.; above that distance, 2 fr.

The Telephone Service.—THE POTTERIES.—The Postmaster-General (Mr. Neville Chamberlain) has made a concession which no previous holder of the office has made. Owing to the blizzard of three weeks ago a thousand local telephones were thrown entirely out of action, and a large number has not yet been restored to service. The P.M.G. has agreed to entertain claims from subscribers and to allow rebate of rental for the period during which the service was interrupted, provided the interruption lasted more than one week. It is pointed out, at the same time, that the P.M.G. is expressly covered, under his agreement with subscribers, against any such claims.—*Evening News.*

ELECTROPHONE SERVICE.—The electrophone has been a luxury to be obtained by telephone subscribers in London for over thirty years, but many people familiar with the principles of broadcast radio transmission have no acquaintance with the electrophone. Installed in front of a stage, concert platform, or pulpit, it gathers up music and speech and carries them over the telephone wires to subscribers in their homes, where special receivers are attached to portable stands. The development of broadcasting seems likely seriously to invade the province of the electrophone. The company which, under a licence from the Post Office, operates the electrophone service is, however, facing the new position optimistically. One of the directors stated that they served only a limited section of subscribers, numbering some two thousand, throughout the London telephone area, and the electrophone would always prove attractive to people who wished to listen, with a minimum of trouble, to an entertainment or church service of their own choosing. Radio amateurs at present, it was pointed out, had to be content with what was given them.—*The Times.*

NEW HELSBY EXCHANGE.—A new telephone switchboard was opened on January 18th at Helsby, replacing with up-to-date apparatus the existing switchboard. Subscribers retain their present numbers, and the new exchange is to serve the same area as previously.

United States.—"BROADCASTING" TO EUROPE.—At the end of the present month the Bamberger broadcasting station, Newark, New Jersey, is to attempt to transmit the whole of a recital by Miss Edith Bennett, an American soprano, to Europe. The speech and music transmitted from the station are already heard distinctly at Panama and places on the Pacific Coast, and successful results are therefore anticipated.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—MELBOURNE.—Electricity Commissioners. March 15th. Motors, starting and isolating switches. (January 12th.)

April 28th. Transformers and spares. (January 12th.)

Melbourne and Metropolitan Tramways Board. March 28th. Manual control gear and switchboards for rotary converter sets. Mr. W. O. Strangward, secretary, 673, Bourke Street, Melbourne.

Victorian Railway Commissioners. February 28th. Electric train lighting equipment (axle generator system).*

March 14th. Twenty-five dwarf electric signal mechanisms.*

Postmaster-General's Department. February 21st, Telegraph apparatus. February 22nd, switchboard parts. March 1st, telephone and telegraph parts. March 16th, telephone and switchboard parts and wires. March 21st, testing and protective apparatus. (January 19th.)

SYDNEY.—April 30th. City Council. Protective apparatus for the Pyrmont power house.—*Reuter's Trade Service* (Melbourne).

Belfast.—January 30th. Electricity Department. One electrically-driven centrifugal pump, 18,000 g.p.m. (January 12th.)

Belgium.—Municipal authorities of Hermalie-sous-Huy. For the concession for the supply of electrical energy for lighting and power purposes in the town.

TOURNAI.—February 13th. Electric supply to the city. Particulars, Service des Travaux, 58, Rue Saint-Martin, Tournai.

Chile.—SANTIAGO.—April 10th. Chilean State Railways. Electrical material.*

Clacton.—March 7th. Electricity Department. One 340-b.h.p. Diesel engine, one 225-kW multipolar shunt-wound generator, cooling plant, steel structure and pipework. (See this issue.)

Eastbourne.—February 10th. Electricity Department. Coal suction conveying plant. (January 12th.)

Egypt.—CAIRO.—March 15th. Minister of the Interior. Supply of electrical fittings for 12 months. Director, Personal and Equipment Department, Ministry of the Interior, Cairo.

February 7th. Ministry of the Interior. Stores, including electrical goods, for 12 months for the Prisons Department.*

France.—PARIS.—January 15th-March 31st. Construction of two 120,000-V transformer stations at Laneuville and Landres respectively. Particulars from the Ministère des Travaux Publics (Service Central des Distributions d'Energie Electrique), Paris.

Gravesend.—January 30th. Electricity Committee. One draught-tube water-tube boiler and accessories. (January 12th.)

Ilford.—February. Urban District Council Electricity Department. E.h.p. and l.p. cables, feeder pillars and stoneware ducts. (See this issue.)

Leicester.—March 12th. Sewage Works and Farms Committee. Designs and quotations for steam, electrical or other type pumping machinery in connection with the sewage disposal of the city. (See this issue.)

London.—HAMMERSMITH.—January 31st. Electricity Department. Stores (including insulated wire, jointing material, meters, &c.) for 3, 6, or 12 months. (See this issue.)

Maidenhead.—January 29th. Town Council. Wiring and fitting isolation hospital for electric light. Borough surveyor.

Manchester. — February 12th. Electricity Committee. 33,000- and 6,600-V switchgear and resistances. (January 12th.)

New Zealand.—INVERCARGILL.—January 31st. Southland Electric Power Board. Outdoor transformer station equipment for the Monowai hydro-electric development scheme.*

WELLINGTON.—February 27th. Public Works Department. 110,000-V insulators in connection with the Mangahao power scheme.*

March 27th. Lightning arresters.*

March 20th. 110 galvanised steel transmission-line towers complete.*

February 20th. Posts and Telegraph Department. 3,000 switchboard plugs.*

CARTERTON.—March 31st. Wairarapa Electric Power Board. 11,000-V switchboard. Mr. P. H. Smith, manager, Carterton. —*Reuter's Trade Service* (Melbourne).

Pontllanfraith, Mon.—February 15th. Mynyddislwyn Urban District Council. Overhead distribution line, cables, services, two 75-kVA transformers, 11,000 and 400-V, 3-h.p. switchgear. (See this issue.)

Rochford.—January 31st. Board of Guardians. Electrical equipment for the Poor Law Institution. (See this issue.)

Skipton.—February 5th. Electricity Department. E.h.p. and l.p. switchgear and transformers. (January 19th.)

South Africa.—JOHANNESBURG.—February 8th. Municipal Council. Tramway spares.*

March 5th. Tramway spares.*

According to the *South African Mining and Engineering Journal*, the Johannesburg Municipal Council has decided to call for tenders for a 8,000-kW generating set, with switchgear, cables, &c., and one 45,000-lb. boiler.

PORT ELIZABETH.—April 16th. Municipal Council. One 3,000-kW turbo-alternator, boilers, coal hoppers, coal conveyor, boiler house, steam and feed-water pipes, &c.*

CAPE TOWN.—Electricity Department. March 23rd. Two-phase induction voltage regulator.*

Stoke-on-Trent.—February 7th. Electricity Department. Two steam jet air pump equipments; 18 months' supply a.c. and d.c. meters. (See this issue.)

Torquay.—February 2nd. Electricity Department. Circulating water pumps, water pipes, and valves. (February 19th.)

Uruguay.—MONTE VIDEO.—March 15th. State Electricity Works, 1,500 d.c. meters and accessories, 8,500 a.c. meters, &c.* March 10th. 66,000 metres of h.p. cable and accessories.*

Warrington.—February 19th. Electricity Department. L.p. lead-covered cable; transformers. (See this issue.)

*A copy of the plan, specification, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Aylesbury.—Town Council. Accepted:—
Recording voltmeter.—Evershed & Vignoles, Ltd.
500 yd. of "A" cable (£77).—Enfield Cable Co.

Belgium.—BRUSSELS.—Belgian Post and Telegraph authorities. For the supply and laying of a large quantity of telephone cables in the Louvain district. Three firms, one each Belgian, German, and Czecho-Slovakian, submitted tenders for the order, the lowest offer being that of the Bratislava Cable Works, of Bratislava, Czecho-Slovakia.

Nine tenders—six Belgian, two Italian, and one German—were opened by the Belgian State Railway authorities for 50 kilometres of insulated copper wire. The lowest offer was that of Kamps & Co., of Brussels.

Eight concerns—four Belgian and one each Dutch, Italian, Swiss, and British (Metropolitan-Vickers Electrical Co., Ltd.)—submitted tenders on January 9th to the municipal authorities of Saint Gilles, near Brussels, for the supply of an 800-kW motor transformer set, with accessories. The lowest offer (126,850 fr.) was that of the Société des Constructions Electriques Belgique, of Brussels.

There was keen international competition for the Belgian State railway contract for the supply of 20,000 metres of insulated copper wire and 5,000 metres of copper cable. Fourteen offers were received—eight being from Belgian concerns, two Italian, and one each Austrian, German, French, and Czecho-Slovakian. The lowest tender was that of the Kabelfabrik Gesellschaft, of Vienna.

Faversham.—Town Council. Accepted:—
Renewing the battery at the electricity works (£442).—Pritchett & Gold and E.P.S. Co., Ltd.

Glasgow.—Electricity Committee. Accepted:—
An automatic telephone installation in connection with the Electricity Department (£2,100).—Western Electric Co.

Government Contracts.—The following Government contracts were placed during December, 1922:—

WAR OFFICE.
Battery boxes.—Accumulators of Woking, Ltd.
Electric cells.—Ever-Ready Co. (Great Britain), Ltd.; Siemens Bros. and Co., Ltd.
Night target lamps.—General Electric Co., Ltd.
Wireless valves.—British Thomson-Houston Co., Ltd.; A. C. Cossor, Ltd.; General Electric Co., Ltd.; Mullard Radio Valve Co., Ltd.

AIR MINISTRY.
Amplifiers.—General Electric Co., Ltd.; Marconi Scientific Instrument Co., Ltd.
Battery charging sets.—Boulton & Paul, Ltd.; Russell, Newbury, Ltd.
Motor alternators.—Crompton & Co., Ltd.
D.c. motors and spares.—British Thomson-Houston Co., Ltd.
Rewinding generators.—Collins Electrical, Ltd.
Sparking plugs (K.L.G.).—Robinhood Engineering Works, Ltd.
Valves.—Mullard Radio Valve Co., Ltd.; Edison Swan Electric Co., Ltd.; British Thomson-Houston Co., Ltd.

CROWN AGENTS FOR THE COLONIES.
Lux cells, &c.—Chloride Electrical Storage Co., Ltd.
Electric motors.—Metropolitan-Vickers Electrical Export Co., Ltd.
Transformers.—Brush Electrical Engineering Co., Ltd.
Copper wire, &c.—F. Smith & Co., Ltd.

POST OFFICE.
Telegraph apparatus.—Creed & Co., Ltd.
Telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Testing protective apparatus.—Phœnix Telephone and Electric Works, Ltd.; Siemens Bros. & Co., Ltd.; E. Turner.
Bowls for electric light fittings.—S. Heath & Sons, Ltd.
Submarine cable.—Telegraph Construction and Maintenance Co., Ltd.
Telegraph and telephone cable.—Connolly's (Blackley), Ltd.; Enfield Ediswan Cable Works, Ltd.; General Electric Co., Ltd.; Hackbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Dry cells.—Ever-Ready Co. (Great Britain), Ltd.; Siemens Bros. and Co., Ltd.
Loading coils.—Western Electric Co., Ltd.
Cords for telephones.—British Insulated & Helsby Cables, Ltd.
Ducts.—Albion Clay Co., Ltd.; Donington Sanitary Pipe and Firebrick Co., Ltd.; Doulton & Co.; Hepworth Iron Co., Ltd.; J. Oakes and Co.; Oates & Green, Ltd.; Sutton & Co. (Overseal), Ltd.
Conduit fibre.—Key Engineering Co., Ltd.
Steel pipes.—British Mannesman Tube Co., Ltd.; Stewart & Lloyds, Ltd.
Lead sleeves.—Baxendale & Co., Ltd.; G. Farmiloe & Sons; W. T. Glover & Co., Ltd.
Solder.—British Insulated & Helsby Cables, Ltd.; E. Cowles; Quirk, Barton & Co., Ltd.; Tyne Solder Co.
Adhesive insulating tape.—W. T. Henley's Telegraph Works Co., Ltd.
Bronze wire.—Enfield Ediswan Cable Works, Ltd.; Shropshire Iron Co., Ltd.
Copper wire.—Enfield Ediswan Cable Works, Ltd.; Shropshire Iron Co., Ltd.
Switchboard wire.—General Electric Co., Ltd. (Peel-Conner Telephone Works).
Manufacture, supply, drawing-in and jointing of cable.—Manchester-Liverpool: British Insulated & Helsby Cables, Ltd.
Lift (Reading Post Office).—W. Wadsworth & Sons, Ltd.

London.—ST. MARYLEBONE.—With further reference to the note on p. 102 of the ELECTRICAL REVIEW, January 19th, the following are the complete recommendations of the Electricity Committee, subject to the approval of the Electricity Commissioners:—

One 12,500-kW turbo-alternator, with condenser.

Maker.	Price.	Delivery.	Remarks.
	£		
Allgemeine Elektricitats Gesellschaft	30,000	13 months	(German.) Not suitable with cast-iron casing at high pressure end of turbine.
Brown, Boveri & Co., Ltd.	36,100	11 ,,	(Swiss.) Own condenser.
	38,168	11 ,,	,, Worthington-Simpson condenser.
Oerlikon, Ltd.	**39,728**	10 ,,	(Swiss.) Worthington-Simpson condenser.
Escher, Wyss & Co. ...	42,979	9 ,,	(Swiss.) Own condenser and Eng. Elec. Co.'s condenser.
Gen. Electric Co., Ltd.	**45,000**	10 ,,	Worthington - Simpson condenser.
C. A. Parsons & Co., Ltd.	50,335	9½ ,,	Own condenser.
Do. do.	51,750	9½ ,,	Worthington - Simpson condenser.
Richardsons, Westgarth & Co., Ltd.	51,007	1 ,,	Own condenser.
Do. do.	51,242		Worthington - Simpson condenser.
British Thomson-Houston Co., Ltd.	51,451	10 ,,	Worthington - Simpson condenser.
Brush Electrical Eng. Co., Ltd.	52,500	28 ,,	Own condenser.
Metropolitan - Vickers Elec. Co., Ltd.	52,840	9½ ,,	Do. do.
Do. do.	53,540	9½ ,,	Worthington - Simpson condenser.
English Elec. Co., Ltd.	54,200	11 ,,	Own condenser.
	54,440	11 ,,	Worthington - Simpson condenser.
J. Howden & Co., Ltd.	53,516	13 ,,	Do. do.
	54,261	13 ,,	Mirrlees-Watson condenser.

The following are the separate subsidiary tenders for condenser plant:—

Maker.	Price.	Remarks.			
	£			Sq. ft.	H.P. of motors
W. H. Allen, Son & Co., Ltd.	12,750	Cooling	surface	20,000	497
Cole, Marchent & Morley ...	12 990	,,	,,	20,600	462
Hick, Hargreaves & Co., Ltd.	13,015	,,	,,	19,000	472
Richardsons, Westgarth & Co., Ltd.	13,205	,,	,,	21,000	538
Worthington-Simpson, Ltd. ...	**13,440**	,,	,,	22,000	452
Vickers, Ltd.	13,590	,,	,,	19,000	515
Mirrlees, Watson, Ltd. ...	14,185	,,	,,	23,000	540

The Committee has decided to put forward for the Council's consideration, alternative recommendations in regard to the tender to be accepted for the turbo-alternator plant, and recommends that the tender of the General Electric Co., Ltd., for a 12,500-kW turbo-alternator and condenser plant, at £45,000, be accepted; that Messrs. Worthington-Simpson, Ltd., be approved as sub-contractors for the supply of the necessary condenser plant; or, alternatively, the tender of Ateliers de Construction Oerlikon, for the 12,500-kW turbo-alternator and condenser plant, at £39,728, be accepted; and that Messrs. Worthington-Simpson, Ltd., be approved as sub-contractors for the supply of the necessary condenser plant.

Two 60,000-lb. steel-cased marine-type boilers, with economisers, stokers, superheaters, all mountings, steel chimneys, &c. :—

Babcock & Wilcox, Ltd. (recommended)	**£42,493**
Clayton & Shuttleworth, Ltd.	42,600
Stirling Boiler Co., Ltd.	43,374
Spearing Boiler Co., Ltd.	47,163
Yarrow & Co., Ltd.	54,800

Fan-draught cooling tower and tank :—

Premier Cooler and Engineering Co., Ltd.	£23,106
Film Cooling Towers, Ltd.	23,496
W. H. Roy Engineering Co., Ltd.	24,980
Glyne Engineering Co., Ltd. (recommended)	**25,580**
Davenport Engineering Co., Ltd.	26,025

Rotary converter sets :—

Maker.	Price each. 1,500 kW.	Price each. 2,000 kW.	Delivery.
	£	£	
Allgemeine Elektricitats-Gesellschaft ...	4,600	5,700	13 months
Mather & Platt, Ltd.	4,614	5,969	7-8½ ,,
Oerlikon, Ltd. (4)	4,850	5,650	7½-8 ,,
do. do. (1)	5,010	5,850	7½-8 ,,
Electric Construction Co., Ltd.	5,245	6,514	12½ ,,
Metropolitan-Vickers Electrical Co., Ltd. ...	**5,549**	7,683	5 ,,
British Thomson-Houston Co., Ltd. ...	5,556	7,683	6 ,,
General Electric Co., Ltd.	5,624	7,466	5½-6 ,,
English Electric Co., Ltd.	5,767	7,891	6½-8½ ,,
Bruce Peebles & Co., Ltd.	5,815	8,735	5-7½ ,,

The Committee recommends that the tenders of the Metropolitan-Vickers Electrical Co., Ltd., for one 1,500-kW rotary converter set to be installed at Aybrook Street sub-station, for £5,549, be accepted; and the General Electric Co., Ltd., for three 2,000-kW rotary converter sets, two for installation at the generating station and one at Rathbone Place sub-station, for £22,365, be accepted.

At the meeting of the St. Marylebone Borough Council on January 18th, the report and recommendations of the Electricity Committee were not reached, but they will be considered at a meeting of the Council on February 1st.

Southend-on-Sea.—Town Council. Accepted:—
Motor generating set, with accessories, for the pier extension (£345).—Crompton & Co., Ltd.

Walsall.—Board of Guardians. Accepted:—
Installation of electric lighting in the infirmary.—Manley & Regulus, Wolverhampton.

Weymouth.—Town Council. Accepted:—
Renewing the battery (exclusive of labour charges) (£116).—Tudor Accumulator Co., Ltd.

FORTHCOMING EVENTS.

Northampton Engineering College Engineering Society.—Monday, January 29th. At the College, St. John Street, E.C. At 5.30 p.m. Paper on "Railway Signals and Signalling," by Mr. G. C. Blofield.

Paisley Association of Engineers.—Tuesday, January 30th. At 99, High Street. At 7.30 p.m. Paper on "Testing of a.c. and d.c. Motors," by Mr. G. P. Rutherford.

Industrial League and Council.—Wednesday, January 31st. At Caxton Hall, S.W. At 7.30 p.m. Lecture on "Industrial Liberty," by Sir Arthur R. Holbrook, M.P.

Chelmsford Engineering Society.—Thursday, February 1st. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "The Electrification of Railways," by Mr. H. Burge.

Finsbury Technical College.—Thursday, February 1st. At the College, Leonard Street, E.C. At 7.30 p.m. Silvanus Thompson Memorial lecture, "The Basis of Wireless Communication," by Sir Oliver Lodge, F.R.S.; conversazione and reunion of old students.

Institution of Electrical Engineers.—Thursday, February 1st. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "The Maintenance of Voltage on a d.c. Distribution System by means of a Fully Automatic Sub-station," by Mr. P. J. Robinson.

(East Midland Sub-Centre).—Tuesday, January 30th. At Loughborough College. At 6.45 p.m. Paper on "The Transmission of Power by Underground Cables at 100/150 kV," by Major A. M. Taylor.

(South Midland Centre).—Wednesday, January 31st. At the University, Birmingham. At 7 p.m. Ordinary meeting.

Chemical Society.—Thursday, February 1st. At Burlington House, W. At 8 p.m. Ordinary scientific meeting.

British Electrical Development Association.—Friday, February 2nd. At Caxton Hall, S.W. At 7.30 p.m. Salesmanship Conference. Paper on "Portable Accessories: Irons, Fans, Small Cookers, &c.," by Mr. C. S. Davidson.

Junior Institution of Engineers.—Friday, February 2nd. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Ventilation and Lighting of Factories," by Mr. P. J. Waldram.

Electrical Power Engineers' Association (Southern Division).—Friday, February 2nd. At the Institution of Electrical Engineers, Victoria Embankment. At 7 p.m. Paper on "Characteristics, Operation and Maintenance of Underground Cables," by Mr. A. I. Tracey.

(Derby and District Section).—Thursday, February 1st. At the Albert Hotel, Nottingham. At 6.45 p.m. Address on "The Influence of Steam Conditions on Power Station Efficiency, with Special Reference to Condenser Performance," by Mr. J. M. Waite.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

WE have to remind readers that Service Department inquiries should be accompanied by a stamped addressed envelope.

The makers or suppliers of the following devices are asked for :—

ASOID fire bars.
FOX electric irons.
Sealing wax heater to melt sticks as required. The pot form of heater is not desired.
AMBROIN insulation.
ECONOMY arc lamps.

NOTES.

Back-to-Back Tests of C.C. Machines.—CORRECTIONS.—The following amendments should be made to the article on pp. 124-6, bearing the above heading :—P. 124, col. 2, formula four lines below the figures should read. "Total loss = $w_g + w_m$, &c." P. 125, col. 1, line 11, should read "Total series copper loss, &c."; line 15 should read : "Iron and friction losses for one machine"; the equation fourteen lines from the bottom of the column should be : "(80+120)/2 = 100 amperes." Column 2, after the word "opposition" in line 22 insert : "in series with a booster." The first equation in this column should read : "$I = E_B/(R_M - R_G)$."

The Registration of Electrical Contractors.—A voluntary scheme of registration of electrical contractors has been approved by a Committee set up by the Institution of Electrical Engineers, and invitations have been issued to the constituent bodies of this Committee, as under, to nominate representatives should they desire to be represented on the registration authority :—

The Institution of Electrical Engineers.
The Electrical Contractors' Association (Inc.), including North Ireland.
The E.C.A. of Scotland.
The Electrical Contractors of the Irish Free State.
Royal Institution of British Architects.
Provincial Electric Supply Committee of the United Kingdom.
Incorporated Municipal Electrical Association.
Incorporated Association of Electric Power Companies.
Conference of Chief Officials of London Electric Supply Companies.
Association of Consulting Engineers.
British Electrical Development Association.
B.E.A.M.A.
Fire Offices Committee.
Electrical Wholesalers' Federation.

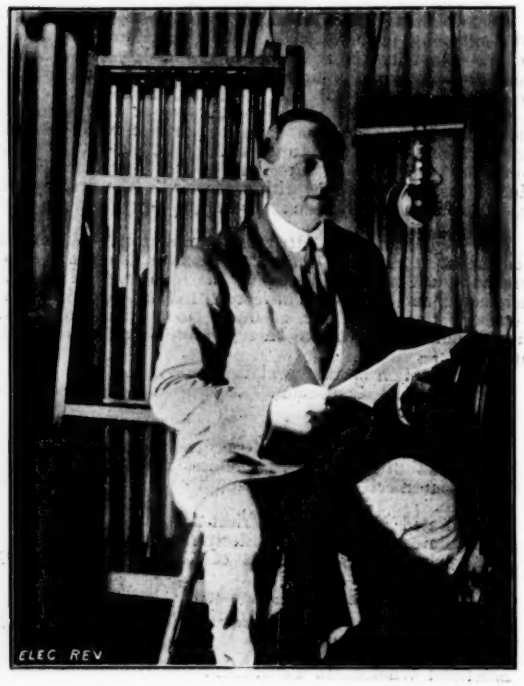
East Midlands Electricity District.—An inquiry into a scheme of a far-reaching character in relation to electricity supply in East Midland areas was opened at the Guildhall, Nottingham, on Tuesday by the Electricity Commissioners, under the chairmanship of Sir John Snell, who, at the outset of the proceedings, referred to the fact that the investigation, which was originally fixed for July of last year, had been postponed in order that negotiations might be completed between the power supply undertakers. The result was that an amended scheme had now been brought forward, with the suggestion that an Advisory Committee should be formed.

Mr. Tyldesley Jones, in presenting the proposals of the East Midlands Conference, dealt with the various projects which had been brought forward within the last three or four years for supplying electricity within the area, explaining that the new plan now submitted dealt with a territory of about 1,000 square miles. Its main feature was that instead of there being one new generating station built at Long Eaton, as originally proposed, with an ultimate capacity of 250,000 kW, three main sources of supply should be adopted with stations at Derby, Leicester, and Nottingham. It had been recommended by the engineers, Messrs. Rider and Wordingham, that the capacity of the Derby station should be extended to 40,000 kW, and that at Leicester to 50,000, whilst with regard to Nottingham it was proposed that the ultimate extent should be 250,000 kW, having regard to the greater capacity there of the Trent for condensing water, and that eventually the three stations should be linked. It was further recommended that whilst other existing stations at Burton-on-Trent, Long Eaton, Loughborough, and Mansfield should have certain small extensions to meet immediate demands, they should be ultimately closed down. The scheme also provided that the Loughborough, Mansfield, Long Eaton, and Ilkeston stations should be shut down as soon as a bulk supply could be made available for the areas affected. There was further the possibility that a new station would be erected at Newark of eventually 200,000 kW capacity as the development of the eastern part of the district necessitated.

The inquiry was expected to last several days.

Accident.—While engaged working at a manhole, two of the Wimbledon Corporation electricity department's employés, Samuel Coombs and James Stenning, received serious burns about their hands and heads through an explosion of coal gas which had accumulated.

Broadcasting in London.—Probably no factor in the history of British broadcasting has been more effective as an advertisement of its merits than the excellent transmission of the opera, which unfortunately came to an end, for the presets within a moderate range of Marconi House, as well as more distant listeners with valve receivers, were able to enjoy music most admirably rendered and faithfully reproduced, as well as the speeches of Dame Nellie Melba and Mr. Paget Bowman at the close of the run; the latter made a special reference to the fact that the Opera had been enjoyed by thousands of listeners, some as far away as Stockholm and Madrid, and he addressed part of his speech directly to them. Messrs. Cunningham inform us that at their premises in Edgware Road over 1,000 persons heard the



performance on Saturday on a loud speaker operated by a 3-valve set of their make—an example of a contractor who is certainly missing no opportunities for popularising the system.

We give herewith a view of Mr. Arthur Burrows broadcasting the news from Marconi House; this will enable our readers to introduce "Uncle Arthur" to their young folks, whose enjoyment of the "children's stories" and of the frolics indulged in by him, together with "Uncle Jeff" and "Uncle Caractacus," is shared by many grown-ups. We surmise that the peal of tubular bells visible in the view is the source of the chimes which mark the hour of commencing the programme—and have a suspicion that the timing is not necessarily coincident with that of "Big Ben."

A False Accusation.—The fire which took place at Messrs. Liberty's, Argyle Street, W., on Saturday last, has been referred to in some newspapers as "the cause unknown, but supposed to be due to the fusing of an electric wire" or "short circuit in electric current used for the cranes."

Mr. Beauchamp, director of the British Electrical Development Association, has made careful inquiry into this matter, and, although unable to obtain fully definite information, the results are as follows:—The fire originated at a point remote from the electrical work, and is generally believed to have originated in a mass of teak sawdust, possibly as a result of spontaneous combustion. A large amount of hard woodwork is being carried out on the site, and there are considerable accumulations of sawdust and shavings. An expert states that teak sawdust is very liable to spontaneous combustion. There was no disturbance whatever on the electricity supply system or evidence to show that anything was wrong with the electrical gear.

Reconstruction of French Institute.—The Ecole Supérieure d'Electricité, founded by the Société Francaise d'Electricité in 1894, having decided that more commodious quarters are needed than those suited to its early beginnings, has resolved to build a new school and laboratory, at an estimated outlay of 9,600,000 fr. In order to carry out this scheme a Société anonyme with a capital of 12,000,000 fr. has been formed, to by styled la Société pour la Développement du haut Enseignement Electrotechnique en France, and subscriptions to one-third of the total have already been received. The objects aimed at are not only the training of expert engineers but the encouragement of electrotechnical research.

Automatic Temperature Control.—Those interested in the increasing use of central heating in this country were given information which would lead to economy in working and also in fuel by Mr. B. R. Wingfield, Ph.D., M.I.E.E., at a meeting of the Institution of Heating and Ventilating Engineers, on January 12th. After describing various types of regulators, he remarked that he was convinced that overheating would be avoided, and that there would be a saving in fuel to the ultimate benefit of the community, if temperature regulation was made a regular part of every central heating installation, whether large or small. Increased numbers of installations would bring down first costs and the reputation of central heating of being a costly and, therefore, a luxurious method of warming, which only the wealthy could afford, would disappear. The question of reliably-regulated and simple central heating was very important at the present time, when on account of the difficulty of getting domestic help, the question of the "labour-saving house" was a subject of frequent discussion. There was no reason why a carefully planned hot-water heating installation should materially add to the cost of, say, a five or six-roomed house, if the saving in chimneys and fireplaces was taken into account.

Irish Water-power Resources.—At a meeting of the Institution of Civil Engineers in Ireland, Dr. M. A. Hogan, B.E., M.Sc., Technical Officer of the River-gauging and Tidal Currents Committee, Department of Scientific and Industrial Research, London, read a paper on "The Development of Irish Water Power Resources and the Need for a Hydrometric Survey." Dr. Hogan cited the Article of the Free State Constitution which declares State ownership of all water, and argued that such ownership implied a survey and suitable legislation, the latter allowing the individual or the company developing the power sufficient freedom and security, while at the same time safeguarding the public interest. The hydrometric survey should be entered upon at once. River gauging was the only practical method of carrying out the work of a hydrometric survey, *viz.*, the collection of details of the volume of water discharged by the rivers, and of the variation of the discharge in the year and from year to year. River gauging required the calibration of the gauging station, usually by means of an electric current meter, involving the discharge of the river at various stages in order to produce a discharge curve, and continuous observations of the water level at the gauging station. As data of the quantities of water available were the essential bases of all estimates of water power, it would be best to postpone the question of a final inventory of their water power resources until the results of a few years of stream gaugings were available.

Mr. E. M. Harris thought State control of water-power resources was necessary, so that development might not be hampered by private interests; but he took the view that they should not approach the problem in Ireland as if the country were a new one and as if nothing were already known of their water resources.

Mr. J. Chaloner Smith remarked that Dr. Hogan's was the first important paper contributed there by a graduate of the National University, and it was a hopeful augury that the author was a distinguished pupil of their president (Prof. P. F. Purcell).

Notes on the Welding Arc.—In the article by Mr. W. Langdon-Davies, which appeared in our issue of January 12th, the following corrections by the author were accidentally omitted: P. 46, second column, third line, delete the word "probably." In the fifth paragraph of the same column, line nine, for "chance" read "fact."

The Electrification of France.—The French Parliamentary Committee of Commerce is engaged on the consideration of the problem of the general electrification of France. At a meeting of the committee held last week emphasis was laid upon the national character of the question and the necessity of making an appeal for its solution to a close co-operation of the electricity and railway companies with the members of Parliament. A sub-committee composed of members of the Chamber and manufacturers and technical men is to be appointed to promote this object.

The German Atlantic Cable Question.—It is understood in well-informed circles in Berlin that the directors of the German Atlantic Telegraph Co., of Cologne, are in promising negotiations with an American group in regard to the grant by the latter of a loan for the establishment of a direct cable to the United States. Foreign aid in this respect is necessary, as owing to the depreciation of the mark it would have been impossible to raise sufficient funds in Germany, and the compensation from the Reich for the loss of cables is also inadequate to accomplish the object in view. It is denied that the company has been transformed into a Portuguese company or has come under the influence of an American group or that its shares and debentures have been exchanged for similar holdings in foreign currency. The German Atlantic, it is emphasised, is and will remain an independent German company.

South African Electricity Act.—With reference to the above Electricity Act, 1922, H.M. Senior Trade Commissioner has forwarded a copy of the regulations made under Section 53 of the Act, which can be consulted by United Kingdom firms interested on application to the Department of Oversea Trade (Inquiry Room), 35, Old Queen Street, London, S.W.1.

INSTITUTION NOTES.

Institution of Electrical Engineers.—At the ordinary meeting on January 18th, the President announced that an invitation was extended to members to attend the Silvanus Thompson Memorial Lecture, which is to be delivered at the Finsbury Technical College, E.C., by Sir Oliver Lodge, on February 1st.

He then introduced to the members present Dr. Nichols, who is in this country for the American Telephone & Telegraph Co., in connection with the trans-Atlantic radio-telephony transmission, mentioned in our last issue. Dr. Nichols, in a brief speech, expressed his thanks for the reception accorded him, and said that he hoped the tests would bring about a closer union between the two peoples. Whenever there was a demand for it a radio-telephone circuit could now be engineered with certainty. He concluded with a eulogistic reference to the efficiency of the British electrical engineers with whom he had recently been associated.

Afterwards Mr. Nelson read his paper on "Works Production," which is abstracted elsewhere in this issue.

STUDENTS' SECTION.—On December 8th, Mr. H. H. Long read a paper on "Scientific Illumination," in which he dealt with the correct measurement of light intensities, stating the laws governing illumination, and describing the apparatus used. The paper was read again at the Sheffield Students' Section on December 13th.

NORTH-WESTERN CENTRE.—The annual dinner of this Centre is to be held at the Midland Hotel, Manchester, on February 23rd. An excellent musical programme is being arranged. Tickets (price 12s. 6d.) may be obtained from the chairmen, vice-chairmen, secretary, and one or two other members.

SCOTTISH CENTRE.—*Annual Dinner.*—The dinner will take place on March 5th, 1923, at the Central Station Hotel, Glasgow. Tickets, 17s. 6d. each, exclusive of wines, can be obtained from the convener of the Entertainments Committee, Mr. W. L. Winning, 166, St. Vincent Street, Glasgow, members of committee, or from the hon. secretary, and applications, together with names of guests, should be sent in as soon as possible. The President of the Institution, Mr. Frank Gill, will be present.

WESTERN CENTRE.—A meeting of the Western Centre was held on Monday last at Bristol, when the Chairman (Mr. F. Tremain) presided over a large attendance of members and visitors. The Joint Hon. Secretary (Mr. Allan) presented his membership report, which showed the strength of the Centre to be 515. The feature of the evening was the attendance of the President (Mr. Frank Gill, O.B.E.), who, after the transaction of the routine business, delivered an address on "Engineering Economics," in the course of which he emphasised the fact that it was the duty of the engineer, if he were to be worthy of the name, to apply progress to science in such a way as to get what he wanted with the least cost. This would tend to the lowering of prices, and if prices were lowered, new markets would open up. Mr. Gill concluded his address by a brief reference to international telephony.

After the ordinary meeting, the President was entertained to dinner, at which the Chairman was supported by Prof. Wertheimer (Dean of the Faculty of Engineering, Bristol University), Mr. Luke, Postmaster of Bristol, and several of the past-presidents of the Western Centre. Responding to the toast of "The Institution," Mr. Gill said that with the Charter a new Institution was called into being, for it meant recognition of work accomplished, and with that recognition came responsibility. Electrical engineering pervaded all forms of human activity, and that being so, the Institution was going to occupy in the future a far bigger position in the affairs of the nation than it did at present. Its utility, however, would depend very largely on the drive and push of its members. He had often heard men say what did they get out of the Institution; his (Mr. Gill's) reply was that they could not get more out of an ordinary machine than was put into it. In proportion to what they did, so would they receive. He took the opportunity of publicly acknowledging the great debt which the Institution owed to the University of Bristol and to Prof. Wertheimer and Prof. D. Robertson in particular.

During the evening several excellent musical items were rendered by Messrs. J. G. Royce, Mahoney, and Huntingdon, Mr. J. Fitzgerald acting as an efficient and accomplished pianist.

Institution of Automobile Engineers.—The Summer Visit is to be held in Liverpool, commencing June 18th. The Motor Critics' Circle has received general approval and the first meeting is to be held on February 21st, when the question of lubricating oils will be discussed. Later, there will be an "inventors' evening," when those who have automobile inventions which have not yet been marketed will have an opportunity of demonstrating them.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

At the meeting of the Institution of Electrical Engineers, to be held on Thursday, February 1st, the President will present to Mr. J. W. MEARES, C.I.E., M.I.E.E., late local hon. secretary of the Institution in India, and electrical adviser to the Indian Government, a salver and cigarette box, subscribed for by his friends in India on the occasion of his retirement from the Indian Government Service, and as a token of his valuable services to the profession in India.

The London County Council Special Committee on London Electricity Supply recommends that owing to the resignation of Lord Monk Bretton, Mr. W. F. MARCHANT be appointed a member in his stead.

At a special meeting of the Wallasey Council, Mr. H. C. LINCOLN, engineer of the Sheffield Corporation, was unanimously recommended for the position of tramways manager, in succession to Col. R. Greene, who retired last April. There were originally 52 applicants for the position, and these were reduced to nine, including three local men.

Mr. J. F. SIMPSON, the new electrical engineer to the Preston Corporation, has been presented with a cheque on vacating the office of tramways manager, which he had held for 17 years.

Preston Electricity Committee has recommended the Council to assess the amount of compensation to be paid to Mr. J. H. TONGE, for the abolition of his office as engineer of the National Electric Supply Co. at £645 11s. 11d. annually, a portion of such pension to be commuted by payment of approximately £2,000, if terms can be agreed. The Committee also recommends compensation to Mr. T. CROSS, secretary to the company, at £343 6s. 8d. annually.

Mr. T. MALCOLM RITCHIE, managing director of the Electrical Equipment Manufacturing Co., South Melbourne, was in December elected president of the Electrical Federation (Victoria). This is Mr. Ritchie's second year of office.

Mr. W. H. VARNOM, of Messrs. Donovan & Co., Ltd., Birmingham, has undergone a severe illness and will be absent from business for a few weeks.

Mr. J. W. KIRKLAND, who for many years has been managing director of the South African General Electric Co., of Johannesburg, has been appointed manager of the London office of the International General Electric Co., of New York. Mr. Kirkland will arrive from South Africa to take up his new duties about March 1st.

Mr. H. S. Dix, chief tramway manager with the Melbourne Tramways Board, resigned his position on December 9th. He was intending to leave for a trip to England in February, but the Melbourne newspapers state that he has decided to retire altogether from active professional duties. He went from England about 18 years ago to take up a position with the Colombo Tramways & Lighting Co., and in 1909 he joined the Prahran-Malvern Tramways Trust.

It is officially announced that Mr. W. A. VALENTINE, deputy controller, has been appointed controller of the London Telephone Service, in succession to Mr. G. F. Preston, who retires at the end of January.

Obituary.—MR. G. CROSSLAND TAYLOR.—Mr. George Crossland Taylor, to whose death we were only able to refer very briefly in our last issue, was led to enter the electrical industry as the result of a visit paid to the Paris Electrical Exhibition of 1881. He abandoned the woollen manufacturing industry, in which he had been thoroughly trained, and in February, 1882, commenced the manufacture of cables, G.P. wires, &c., as G. C. Taylor & Co., Deeside Electric Works, Deeside, Neston. Improvement in the plant were necessary and these were effected with the assistance of Mr. F. Whiteley, and in 1884 the first braiding machine was run by Mr. Whiteley. In that year, also, Mr. James Taylor joined the firm and later to the two brothers, the late Mr. J. Slater Lewis was introduced with his patent screw-top porcelain insulator. In 1886 Messrs. Taylor & Co. converted the business into the Telegraph Manufacturing Co., Ltd., and in the same year they acquired the business of Mr. Slater Lewis, and this gentleman joined the board as managing director. Two acres of land had been acquired in the village of Helsby, forming the nucleus of the thirty acres on which the present works stand. The Neston plant was transferred there and in 1887 the manufacture of telegraph instruments and other articles was added to the company's activities. In 1888 the company put down its own rubber mixing plant; it was already making its own bricks. Mr. Slater Lewis left the company in 1889, and the brothers Taylor and Mr. Whiteley took up the management of the Helsby works, each gentleman having his own province clearly marked out. Technical and business developments were continuous from that time leading in 1898 to reconstruction of the company and the introduction of more capital. Sir (then Mr.) J. S. Harmood Banner joined the board. In 1902, the great increase in competition rendered it necessary to increase turnover, especially of heavy cables, and the Telegraph Manufacturing Co., Ltd., sold itself to the British Insulated Wire Co., Ltd., of Prescot. The chairman

(Mr. James Taylor) at one of the meetings held in connection with these proceedings, said that their cables were known as the Helsby cables, and their name was therefore to be embodied in the new title of the joint concern—British Insulated and Helsby Cables, Ltd., as we know it to-day. Mr. George Taylor in the early nineties was responsible for the design of various railway instruments and telephone boards made by the company, and he designed silk covering and improved taping and cotton covering machines.

Wills.—The late MR. H. W. MILLER left £18,782 gross and £18,154 net personalty.

The late Mr. J. G. GRIFFITHS, a director of the Western Telegraph Co., Ltd., and the Globe Telegraph & Trust Co., Ltd., left £216,245 gross, and £210,510 net personalty.

NEW COMPANIES REGISTERED.

Peckham Truck and Engineering Co., Ltd. (187,199).—Private company. Registered January 18th. Capital, £5,000 in £1 shares. To adopt an agreement with a company of the same name and its liquidator, and to carry on the business of mechanical engineers, tool makers, iron and brass founders, metal workers, boiler makers, manufacturers and repairers of and dealers in railway carriages and wagons, tramway trucks and other carriages, &c. The provisional directors are: G. W. Anderson, 26, Audrey House, Ely Place, E.C.1, clerk; F. J. Mansfield, 26, Audrey House, Ely Place, E.C.1, engineer. Remuneration: £50 each per annum. Registered office: Audrey House, Ely Place, E.C.1.

Auto Welding and Engineering Co., Ltd. (187,121).—Private company. Registered January 13th. Capital, £3,000 in £1 shares. To carry on the business of electrical and general welders, solderers and braziers, manufacturers of tanks, constructive ironwork, automatic and other types of measuring pumps and plant, electrical and other welding machinery, tools and general engineering plant, mechanical transport vehicles, &c. The permanent directors are: J. Mackenzie-Russell, 9, Elgin Avenue, Paddington, W.9; G. R. Guinea, 203, Maida Vale, W.9; A. W. Macleod, 78, Nimrod Road, Streatham, S.W.16 (chairman). Qualification: 1 share. Secretary: A. W. Macleod. Registered office: 29a, Portpool Lane, W.C.1.

The Cric Construction Co., Ltd. (187,188).—Registered as a private company on January 18th, with a nominal capital of £1,000 in £1 shares. The objects are: To construct, work, develop, manage or control in South and Central America and elsewhere public works and conveniences of all kinds, including telegraphic, telephonic and radio telegraphic and telephonic, and power supply works, railways, tramways, docks, harbours, piers, wharves, canals, embankments, hotels, warehouses, markets and public buildings; also to carry on business as bankers, financiers, capitalists, concessionaires, electricians, engineers, &c. The subscribers (each with one share) are: F. S. Gaylor, 4, Old Burlington Street, W.1, solicitor; J. Findlay, 4, Old Burlington Street, W.1, secretary. The subscribers are to appoint the first directors. Remuneration: £50 per annum, free of income tax, and 2½ per cent. of the net profits divided between them. The registered office is at Lloyd's Bank Chambers, Henrietta Street, W.C.2.

Bell's Radio and Electrical Co., Ltd. (187,184).—Private company. Registered January 18th. Capital, £4,000 in £1 shares. To adopt an agreement with G. Bell, to acquire and turn to account the benefit of inventions connected with radio telegraphy and telephony and other methods of intercommunication, and apparatus, instruments and appliances connected therewith, &c. The first directors are: E. B. Frail, Ivan Lea, Cleadon, near Sunderland; R. J. Nichol, Linden, Denewell Avenue, Low Fell; J. C. Gunn, 4, Westfield Drive, Gosforth; Dr. A. E. Raine, 13, Grange Crescent, Sunderland; Dr. H. Evers, 2, Portland Street, Jesmond, Newcastle-on-Tyne; Miss E. M. Holmes, 33, Jesmond Road, Newcastle-on-Tyne; J. H. G. Brown, 13, Rowlandson Terrace, Sunderland; G. Bell, 33, Jesmond Road, Newcastle-on Tyne (all permanent, subject to holding 500 shares each). Registered office: 46, Blackett Street, Newcastle-on-Tyne.

British Ozone Appliances, Ltd. (187,147).—Private company. Registered January 17th. Capital, £2,000 in £10 shares. To carry on the business of general, electrical and mechanical engineers and contractors, metal workers, machinists, dealers in electrical apparatus, &c. The subscribers (each with one share) are: L. E. A. Root, 33, Cheverton Road, Hornsey Lane, N.19, secretary; J. Portwine, 14, Sydenham Hill, S.E., merchant. The first directors are: F. W. Osborne, D. H. Hale, J. Weller, J. McBlain, and J. Portwine (chairman). Registered office: 158, Norwood Road, S.E.27.

Drycel, Ltd. (187,152).—Private company. Registered January 17th. Capital, £2,500 in £1 shares. To acquire the business formerly carried on by Lyto, Ltd., at 172, Church Road, Mitcham, as manufacturers of and dealers in electric batteries; also to acquire from W. H. Edridge, A.K.C., A.M.I.C.E., A.M.I.M.E., a licence to manufacture electric batteries and in accordance with inventions of which the said W. H. Edridge is the patentee, &c. The subscribers (each with one share) are: W. H. Edridge, 24, St. Mary Abbotts Terrace, Kensington, W.14, chartered electrical engineer; G. W. Carter, 37, Godson Road, Croydon, solicitor's clerk. The subscribers are to appoint the first directors. Secretary (*pro. tem.*): G. W. Carter. Registered office: 24, St. Mary Abbotts Terrace, Kensington, W.14.

British Wireless (1923), Ltd. (12,517).—Registered in Edinburgh January 16th. Capital, £7,000 in £1 shares (5,000 cumulative preference and 2,000 ordinary). To carry on business in Glasgow as wholesale agents, factors, warehousemen, makers and hirers of all kinds of scientific and electrical apparatus and appliances, &c. The first directors are: Sir Joseph Dobbie, 10, Learmouth Terrace, Edinburgh, solicitor; W. J. Kerr, 1, Ibrox Terrace, Glasgow, merchant; T. W. Ferguson, 703, Cathcart Road, Glasgow, chemist; T. Bennet, 291, Sauchiehall Street, Glasgow, plumber; A. T. Dunlop, 27, Newark Drive, Pollokshields, Glasgow, merchant; A. Ritchie, 21, Dargarvel Avenue, Dumbreck, Glasgow, contractor; W. K. Dewar, Kerrslee, Denmont Road, Glasgow, wireless expert. Minimum cash subscription: 7 shares. Qualification: 100 shares. Remuneration of chairman, £100; of other directors, £50 each per annum. Secretary: J. A. A. Love. Registered office: 24, St. Vincent Place, Glasgow.

British Arca Regulators, Ltd. (187,074).—Registered as a private company on January 13th, with a nominal capital of £60,000 in £1 shares. The objects are: To acquire the rights for the British Empire in certain inventions relating to regulators or devices which prevent undesired or erratic variations of physical, mechanical or material conditions, and in particular patents No. 116,074, of 1919, and 136,540, of 1920, and the British trade mark "Arca"; to adopt an agreement with Aktiebolaget Arca Regulatorer; and to carry on either directly or by means of subsidiary companies the business of manufacturers of regulators, machinery, appliances, apparatus, accessories and fittings, mechanical, marine, electric and general engineers, &c. The subscribers (each with one share) are: R. K. Morcom, Clock House, Bromsgrove, engineer; H. T. Denton, Moorland Road, Edgbaston. The directors are to number not less than two nor more than five, of whom three shall be of English nationality and appointed by the subscribers, and two (one of whom shall reside in England) are to be nominated by the said company. Qualification: £1. Remuneration (except managing and specially remunerated directors) as fixed by the company. Solicitors: Pinsent and Co., 6, Bennett's Hill, Birmingham. No notice of situation of registered office was filed at the time of registration.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Implitico, Ltd. (138,160).—Return dated November 17th, 1922. Capital, £3,000 in £1 shares. All shares taken up. £3,000 paid. Mortgages and charges, nil.

Mawdsley's, Ltd. (91,783).—Return dated December 25th, 1922. Capital, £20,000 in £1 shares. 18,937 shares taken up. £6,937 paid. £12,000 considered as paid. Mortgages and charges, £6,300.

Keighley Electrical Engineering Co., Ltd. (44,893).—Return dated December 11th, 1922. Capital, £10,000 in 7,000 ordinary and 3,000 preference shares of £1 each. 4,200 ordinary and 1,800 preference shares taken up. £3,988 paid. £2,012 considered as paid. Mortgages and charges, £5,000.

Manaos Tramways & Light Co., Ltd. (101,081).—Return dated January 2nd, 1923. Capital, £300,000 in £1 shares. All shares taken up. £100 paid. £299,900 considered as paid. Mortgages and charges, £268,800.

C. F. Casella & Co., Ltd. (106,869).—Capital, £17,000 in 15,000 ordinary and 2,000 preference shares of £1 each. Return dated November 17th, 1922. 12,204 ordinary and 2,000 preference shares issued. £3,504 paid. £10,700 considered as paid. Mortgages and charges, £1,800.

Rotax (Motor Accessories), Ltd. (48,936) (originally registered in 1896 as "Newton Electrical Works, Ltd.," and afterwards known as "Newtons, Ltd.," renamed as above in 1921).—Capital, £506,500 in 253,250 ordinary and 253,250 preference shares of £1 each. Return dated February 16th, 1922. 253,033 ordinary and 253,034 preference shares issued. £168,650 paid on 93,650 ordinary and 75,000 preference. £337,417 considered as paid on the remainder. Mortgages and charges, nil.

Europe and Azores Telegraph Co., Ltd. (39,452).—Capital, £200,000 in £10 shares. Return dated October 31st, 1922. All shares taken up. £144,320 paid. £55,680 considered as paid. Mortgages and charges, nil.

Elco Electric Manufacturing Co., Ltd.—J. P. Emett, of Gresham Chambers, 18, Nicholas Street, Bristol, was appointed receiver and manager on January 11th, 1923, under powers contained in debentures dated June 12th, 1922.

Musselburgh and District Electric Light and Traction Co., Ltd.—Satisfaction to the extent of £1,100 on December 20th, 1922, of charges dated November 13th, 1905, and May 11th, 1909, securing £90,000.

Car Ignition and Lighting Co., Ltd.—Particulars filed of £700 debentures authorised January 4th, 1923, charged on the company's undertaking and property, including uncalled capital, the amount of the present issue being £600.

Midland Electric Light and Power Co., Ltd.—Issue on December 15th, 1922, of £4,000 debentures, part of a series already registered.

A. W. Beuttell, Ltd.—Debenture dated January 5th, 1923, to secure £674 2s. 11d., charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. W. Beuttell, "George and Dragon Hotel," Cosham, Hants.

J. B. Saunders & Co., Ltd. (112,037).—Return dated October 27th, 1922. Capital, £20,000 in £1 shares. 18,000 shares taken up. £18,000 paid. Mortgages and charges, nil.

Slough and Datchet Electric Supply Co., Ltd.—Satisfaction in full on December 29th, 1922 (*a*) of debenture dated July 15th, 1919, securing all moneys due or to become due from the company to Barclay's Bank, and (*b*) of further charge dated March 21st, 1921, increasing the rate of interest thereon.

CITY NOTES.

British Columbia Electric Railway Co., Ltd.

THE annual general meeting of the company was held on January 22nd, Mr. J. Davidson (deputy-chairman) presiding. In presenting the report and accounts (which were reviewed in our last issue), Mr. Davidson expressed the regret of the chairman (Mr. R. M. Horne-Payne) at his inability to attend the meeting through illness. He said that the profit on exchange had again been carried to the reserve fund. The gross earnings had decreased by $124,299, mainly due to a decrease in the passenger and freight traffic, but economies in operating expenses, decreased taxation, &c., had enabled them to keep the decrease in net revenue down to $58,410. The amount of electricity sold during the year was 177,206,106 kWh, an increase of nearly two million kWh; steps were being taken to meet the increasing demand. It was the company's hope that the public authorities would join with it in a spirit of mutual interest and reciprocal goodwill. The company had built up a vast enterprise at a cost of $59,000,000; it supplied the most important cities of British Columbia with transportation, heat, power, and light; it had built and equipped 369 miles of electric railway, harnessed and developed four water powers to a total extent of 163,000 h.p., erected a steam reserve plant of 23,000 h.p., and it supplied gas to the extent of 602,030,000 cu. ft. per annum. The report and accounts were adopted, and Mr. Davidson was re-elected deputy-chairman.

Prospectus.—*The Western Electric Distributing Corporation, Ltd.*—The Provincial Underwriters' Association, Ltd., has been offering for sale at par 35,755 6 per cent. cum. pref. shares of £1 each in this Corporation, which owns or has a controlling interest in a number of electric lighting undertakings which have been worked by subsidiary companies for some years in Abingdon, Chippenham, Cirencester, Ledbury, Leominster, Melksham, Ruthin, Stroud, Trowbridge, Tewkesbury, and Warminster. On an issued capital of £44,558 the net profit for the year ended June, 1922, was £4,274, after providing for depreciation, interest, and income tax and managerial expenses. The dividends paid between 1914 and 1922 on a capital which has increased from year to year have

ranged from 5 per cent. to 10 per cent. The Corporation is now about to extend its sphere of operations, and negotiations for electric lighting in other towns are in progress. The proceeds on the issue of preference shares and of £14,847 ordinary shares purchased by the directors (totalling, with a further 4,000 ordinary shares, £52,614) are to be devoted to these purposes. Applications had to be lodged by January 22nd. The directors of the company are:—A. A. Douglas (chairman); J. Herbert Edwards (managing director); S. F. Hawley-Edwards (managing director of the Provincial Underwriters' Association); A. H. Seabrook; and H. W. Woodall.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following to be officially quoted:—

Marconi's Wireless Telegraph Co.—£1,500,000 six and a-half per cent. convertible ten-year first debenture stock.

Bengal Telephone Corporation.—£350,000 7 per cent. first mortgage bonds of £100 each (Nos. 1 to 3,500—bearer).

Vickers.—236 5 per cent. cumulative preference shares (free of tax up to 6s.) of £1 each, fully paid (Nos. 6,863,828 to 6,864,063).

Lanarkshire Tramways Co.—The revenue for the year 1922 was £195,287 and the expenses were £152,818. Various items are deducted, including £10,000 transferred to depreciation reserve, and the available balance, including £2,183 brought forward, is £24,079. An interim dividend at the rate of 5 per cent. per annum was paid for the half-year ended June, and a further dividend at the rate of 6¼ per cent. per annum for the December half-year is recommended. £1,801 is to be carried to revenue new account. There was a decrease of £32,163 in the revenue and £35,692 in the expenses as compared with 1921. Further extensions of the motor-bus services are under consideration.

Vulcanite, Ltd.—The directors' report for the year ended October 31st, 1922, states that during the first half-year's working trade was in an exceptionally depressed state, and business was carried on at a loss, increased by the fall in prices of raw materials for which forward contracts had been entered into. These losses were partly made good by profits earned during the final six months, when business showed a gradual improvement. As the loss on the year's trading was due to abnormal conditions, and is not likely to recur, it was decided to transfer £5,000 to profit and loss from reserve to meet the deficit in trading and provide for dividend on cumulative preference shares. After meeting the preference dividends the directors propose to write off the trading loss for the year, £4,269, carrying forward £1,217.

Charles Churchill & Co., Ltd.—According to the *Financial Times*, the accounts for the year to March 31st, 1922, show a loss of £51,282, reducing credit balance brought down to £27,143, out of which the dividend on preference shares for half-year to September 30th, 1921, has been paid. It is not proposed to pay a balance dividend until an improvement in the position warrants it. £25,343 is carried forward.

French Electrical Companies.—A recent meeting of the shareholders of the *Compagnie Lyonnaise d'Electricité* passed the accounts for the past year, showing a net balance of 306,535 fr., and voted a dividend of 22.25 fr. per share and 92.884 fr. per founder's share. The extraordinary meeting which followed voted an increase of the capital by the distribution of the reserves.

Dublin United Tramways Co., Ltd.—Final dividend at the rate of 7 per cent. per annum, less tax, for the half-year ended December, making 5 per cent. for the year, on the ordinary shares. £55,000 is set aside for track renewal and £14,105 carried forward.

National Boiler and General Insurance Co., Ltd.—Shareholders of this company last week gave their approval to the acceptance of the offer of the Alliance Assurance Co. to acquire their shares, already mentioned here.

STOCKS AND SHARES.

TUESDAY EVENING.

THIS week, the Stock Exchange undertakes a fortnightly settlement of unusual magnitude. It should be a good thing for the City electricity supply companies, because, in the Throgmorton Street area, the light will burn till daybreak in many offices, and for three nights the beds booked for Stock Exchange staffs in various City hotels are not likely to be tenanted for many hours at a stretch. Despite the Ruhr developments and the subdued regrets at the present issue of the Re-Funding Commissioner's efforts in America, the markets are generally hard.

Speculation is engaged with the outlook in the Money Market, which, according to some, sets towards the possibility of money-rates becoming higher at the end of this month. Yet other authorities take a view directly opposite. At present, money is abundant and cheap. New issues find ready subscribers. For sound stock there is a willing public appetite, apart altogether from speculation by the stag party.

Mention of the part played by school-boys in assisting the price of Marconis, through their active interest in broadcasting, and listening-in, may be supplemented by references to a further impetus given to the new hobby by Dame Melba's triumphs at the Opera. These have undoubtedly stimulated fresh attention in the wireless waves, and Marconis, after a dip to 45s. 6d., hardened to 2¾. The debentures keep very hard at 106½; Canadians rose to 11s. 6d. and went back to 11s. Radio preferred and common are 13s. 6d. and 15s. 6d., respectively, the market in them being stagnant and awaiting a New York touch to bring them to life again.

Siemens have drifted back to 20s. sellers. General Electrics are being vigorously supported in quarters outside the Stock Exchange, a fact with which shareholders may not feel greatly elated. The price is 9d. lower on the week. We have also seen advocacy of Edison Swans at about half-a-crown. As one of the papers pointed out, Edison preference, dividendless since July, 1921, stand at 10s. 6d., while the company's 4 per cent. first debenture is quoted at 61, and changed hands a few days ago at 59. No doubt the company is doing much better than it was some time ago, but the prices quoted for the pre-ordinary issues are an index that cautious folk will not ignore.

Proprietors of Kent Electric shares are informed by the company's directors that an offer of 25s. per share has been made for the ordinary, and of a guinea per share for the preference. These prices the Board deem satisfactory, and shareholders are advised to accept them. It makes an interesting sequel to the information given here some weeks ago of the demand which had sprung up for the ordinary, "from Glasgow, of all places," as we remarked at the time. The Scottish buyers wanted the offer of ordinary shares at about 10s., but there was no supply in the London market. Six months ago, the nominal price was about 5s. The present offers, as the directors state, seem to be advantageous enough for shareholders to accept.

Charing Cross ordinary at 8, Edmundson's preference at 4½, Kensington ordinary at 8½ and Metropolitans at 6¾ are all ¼ better. Brompton new shares are 1s. better at 30s. There is still a pronounced scarcity of stock, and, with the dividend declarations so near at hand, proprietors are waiting for the announcements with keen interest. The general expectation may be reiterated that there will be an increase in the dividend rates throughout the list of the London companies. Whitehall Electric 6 per cent. debenture stock has come into favour; it rose a point to 89½. The preference shares are also better at 18s. Investors are buying the former as being a sound investment of its class and offering a satisfactory yield at the present quotation.

Although Metropolitans and Districts are both ¼ lower, Underground Electrics continue their improvement, the ordinary shares of £10 each rising to 3 1/16, and the Income Bonds coming in for pronounced attention at 92½. This last price shows an advance of five points within a fortnight. British Electric Traction ordinary at 64½ is better, and London Suburban Traction preference stiffened to 11s. London United Tramway debenture is ¼ up at 62½.

Foreign traction issues are disposed to be dullish, with Brazil Tractions 1¼ down at 46½, and a general fall amongst Mexican issues. Lack of definite news from Mexico is causing no little disappointment amongst those who, a couple of months ago, were expecting every day to hear that the points of difference between Mexico and the United States had been settled, and that the way was clear for the granting of that loan from the States which would set Mexico upon its financial feet and enable industry to go ahead. Anglo-Argentine Trams are steady, the second preference showing a small improvement and the 5 per cent. debenture stock gaining 1½ points.

The United River Plate Telephone Co. has now issued its letters of allotment in respect of the new shares. The price of these rights is 1¾-1¾ premium. As they are issued at £5 and the existing shares stand at 6¾ cumulative dividend, no particular object can be served by exchanging from the one into the other. In fact, the two quotations, those for the old and the new shares, are unusually close to one another. The Eastern group of cable stocks is firm, Globes being a little harder on the week. Great Northerns fell 10s. to 28¼, in consequence, partly, of the demoralisation of the franc. Anglo-American deferred, after its recent rise, has reacted a trifle.

Amongst the manufacturing shares, British Insulated ordinary lost the improvement which they picked up last week, and Callenders at 2 5/16 are 1/16 lower. On the other hand, India Rubber shares are 1s. better at 12s. 6d. The market is quiet, with changes somewhat irregular. Babcock & Wilcox at 3¾ exhibit ¼ fall, but Vickers rose, under the stimulus of country buying, to 17s., and the tax-free preference to 18s. 6d.

Iron and steel shares as a whole are quite a good market. Activity in most industrials, however, is overshadowed by the boomlet in rubber shares, which continued until the carry-over disclosed a fairly extensive bull position. Some of the buyers who were expecting to be able to carry-over their stock, found themselves disappointed, and consequently had to close their shares for cash, a process which caused a slight dulness. Rubber, the produce, has risen to 1s. 6d. per lb., as against 7d. to which it fell last August. At the former price most of the producing companies can make fair profits, even allowing for the restricted output to which most of them voluntarily agreed under the scheme of the Stevenson Committee, whose recommendations, and the carrying-out of these, are responsible for the remarkable change for the better which has come over the complexion of the rubber industry.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend. 1920.	Dividend. 1921.	Price Jan. 23, 1923.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	30/-	+1/-	£4 0 0
Charing Cross Ordinary	8	9	8	+ ½	5 12 6
do. do. do. 4½ Pref.... ...	4½	4½	4⅞	—	5 7 5
Chelsea	6	6	6⅝	—	4 9 0
City of London	14	14	21	—	6 4 5
do. do. 6 per cent. Pref. ...	6	6	23/-	—	5 4 4
County of London	8	8	1 5/8	—	5 2 5
do. do. 6 per cent. Pref. ...	6	6	1⅛	—	5 4 4
Edmundson's Ordinary	Nil	Nil	2½	—	Nil
do 6 per cent. Pref. ...	6/-	12/-	4⅛	+ ½	6 13 4
Kensington Ordinary	9	10	8⅛	+ ¼	6 5 0
London Electric	2½	4	8	—	4 0 0
do. do. 6 per cent. Pref. ...	6	6	5⅛	—	5 17 1
Metropolitan	7	7	6⅜	+ ⅛	5 5 8
do. 4½ per cent. Pref. ...	4½	4½	4 1/16	—	5 10 9
Newcastle-on-Tyne Ordinary ...	8	Nil	1⅜	—	Nil
do 5 per cent. Pref. ...	5	5	15/9	—	6 7 0
do 7 per cent. Pref. ...	—	7	22/-	—	6 7 3
Notting Hill, 6 per cent. Pref.	6	6	9	—	6 13 4
North Met. Elec., 6 per cent. Pref. ...	6	6	1 1/16	—	5 13 0
Urban Ordinary	Nil	Nil	1⅛	—	Nil
do 5 per cent. Pref. ...	2½	2½	4	—	6 5 0
St. James' and Pall Mall	12	12	9½	—	6 6 4
South London	7	7	4⅜	—	5 18 0
South Metropolitan Pref.	7	7	1 5/8	—	5 18 0
Westminster Ordinary	10	10	8⅛	—	6 3 0
Whitehall Elec. Inst., 7½ per cent. Pf.	—	7½	18/-	+6d.	8 6 8

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	103xd	—	5 16 6
do. Def.	1½	34/6	22⅜	— ½	6 13 4
Chile Telephone	6	6	8⅛	—	4 16 0
Cuba Sub. Ord.	7	7	7⅞	—	9 0 8
Eastern Extension	10	10	19	—	5 5 3
Eastern Tel. Ord.	10	10	180½	—	5 5 6
Globe Tel. and T. Ord.	10	10	19½	—	5 4 0
do. do. Pref.	6	6	11⅛	—	5 6 8
Great Northern Tel.	24	22	28½	—	7 15 0
Indo-European	10	10	35½	—	7 1 0
Marconi...	25	15	23	+ 1/16	6 6 4
Oriental Telephone Ord.	12	12	2 7/16	—	*5 4 0
United R. Plate Tel.	8	8	6⅜xd	—	*6 0 9
West India and Panama	Nil	Nil	7/6	—	Nil
Western Telegraph	10	10	18⅛	—	*5 6 8

HOME RAILS.

Central London Ord. Assented	4	4	67	—	5 19 5
Metropolitan	1½	2½	61½	— ½	3 13 2
do. District	Nil	1	47½	— ½	2 2 1
Underground Electric Ordinary...	Nil	Nil	8 1/16	+ 1/16	Nil
do. do. "A"	Nil	Nil	8/-	—	Nil
do. do. Income	2	4	92½	+2	*4 6 5

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams. First Pref.	5½	12½	38	—	7 11 9
do. do. 2nd Pref.	Nil	5½	3 5/16	+ 1/16	8 8 6
do. do. 5 per cent. Deb. ...	5	5	82	+1½	6 2 0
British Electric Traction Ordinary ...	4½	—	64½	+½	6 19 6
do 6 per cent. Pref. ...	6	6	94	—	6 7 8
Brazil Tractions	Nil	Nil	46½	+1½	8 12 0
British Columbia Elec. Rly. Pcc. ...	5	5	76 1/16xd	—	6 7 5
do. do. Preferred ...	5	9/-	75½	—1	*6 4 0
do. do. Deferred ...	5	12d/-	87½	—	*7 0 6
do. do. Deb.	4½	4½	77½	—	5 9 8
Lond. and Sub. Trac., 5 per cent. Pf....	2½	3½	11/-	+6d.	6 7 3
London United Tram deb.	4	4	69½	+ ½	6 8 0
Mexico Tram. 5 per cent. Bonds ...	Nil	Nil	78½	—3	6 7 5
do. 6 per cent. Bonds ...	Nil	Nil	66½	— 3	Nil
Mexican Light Common...	Nil	Nil	21½	—	Nil
do. Pref.	Nil	Nil	49½	—2	Nil
do. 1st Bonds.	Nil	5	67	—	7 8 2

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	16	38	—½	4 14 6
British Aluminium Ord.	10	5	18/3	—	5 9 7
British Insulated Ord.	15	15	2 7/16	+ 1/16	6 9 10
Callenders	15	15	2 1/16	—	6 13 4
do. 6½ Pref....	6½	6½	1⅛	—	5 15 7
Crompton Ord.	10	5	16/3	—	6 3 1
Edison-Swan	10	Nil	2/6	—	Nil.
do. do. 5 per cent. Deb.	5	5	61	—2	8 1 4
Electric Construction	10	10	1⅜	—	7 5 6
English Electric	8	5	16/9	—6d.	5 19 5
do. do. Pref.	6	6	1	—	6 0 0
Gen. Elec. Pref.	6½	6½	21/9	—	5 19 6
do. Ord.	10	5	19/3	—9d.	5 4 0
Henley	15	15	2⅜	—	6 6 4
do. 4½ Pref.	4½	4½	4⅜	—	5 2 10
India-Rubber	10	—	12/6	+1/-	—
Met.-Vickers Pref.	8	8	9 1/16	—	6 11 2
Siemens Ord.	10	10	1	—	Nil.
Telegraph Con.	20	20	25⅛	—	*4 11 6

* Dividends paid free of Income Tax.
† New shares.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.	Price January 24th.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	6½d.	...
a Ammoniac, Sal ... ... per ton	£63	...
a Ammonia, Muriate (large crystal) ,,	£48	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax... ... ... ,,	£28	...
a Copper Sulphate ... ... ,,	£26 15s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	6½d.	...
a Shellac ... ... per cwt.	£19	...
a Sulphur, Sublimed Flowers ,,	£9	...
a ,, Lump ... ... ,,	£9 2s. 6d.	...
a Soda, Chlorate ... ... per lb.	9½d.	...
a ,, Crystals ... ... per ton	£6	...
a Sodium Bichromate, casks ... per lb.	5d.	...
METALS, &c.		
b Aluminium, Ingots... ... ... per ton	£100	...
b ,, Wire ... ... per lb.	1/9 to 2/6	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£168	£4 inc.
Grade II ... ... ,, ,,	£124	£3 inc.
Grade III ... ... ,, ,,	£69	£1 inc.
c Brass (rolled metal 2" to 12" basis) per lb.	9½d.	...
c ,, Tubes (solid drawn) ,, ,,	11¾d. to 1/-	...
c ,, Wire, basis ... ... ,,	9¾d.	...
c Copper Tubes (solid drawn) ... ,,	1/1½	...
c ,, Bars (best selected) ... per ton	£96	...
c ,, Sheet ... ... ,,	£96	...
c ,, Rod ... ... ,,	£96	...
d ,, (Electrolytic) Bars ... ,,	£70-15s.	20/- dec.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, * Wire Rods ,,	£80 15s.	20/- dec
d ,, ,, H.C. Wire per lb.	10 1/16d.	½d. dec.
f Ebonite Rod ... ... ,,	3/6	...
f ,, Sheet ... ... ,,	3/-	...
n German Silver Wire ... ... ,,	2/6	...
h Gutta-percha, fine ... ... ,,	12/6	...
h India-rubber, Para fine ... ... ,,	1/6	4½d. inc.
l Iron Pig (Cleveland Warrants) ... per ton	92s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual. ,,	£24	...
g Lead, English Pig ... ... ,,	£28 15s.	15/- inc.
g Mercury ... ... per bot.	£11	10/- dec.
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium ... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/1	...
p ,, drawn bars and rods ,,	1/3	...
p ,, rolled strip & sheet ,,	1/2½	...
p ,, wire ... ... ,,	1/8½	...
o Platinum ... ... per oz.	£25	...
d Silicium Bronze Wire ... ... per lb.	1/0½	...
r Steel, Magnet, in bars ... ... ,,	10d.	...
m Tin, Block (English) ... ... per ton	£183 10s.	£4 10s. to £5 10s. inc.
m ,, Wire, Nos. 1 to 16 ... ... per lb.	3/2	...

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
m P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Fire.—An outbreak of fire caused in an unusual manner took place at Messrs. Pennington's cotton waste warehouse, Back Hope Street, Oldham, on the morning of Thursday, January 11th. A live electric wire came into contact with a gas pipe leading to the gas meter, with the result that a hole was burned into the pipe and the gas ignited. There was a strong rush of gas, which blazed furiously. Machines from the Central and Townfield fire stations were quickly on the scene, and fortunately the damage done was only slight.

Naval War Inventions.—The Admiralty has decided that some of the many inventions by naval officers and men that were kept secret may now be used by their inventors.—*Daily Mail.*

Lectures.—At a meeting of the Nottingham Society of Engineers, on January 24th, Mr. H. Cotton, M.Sc., M.B.E., lectured on "Variable Speed Drives from an a.c. Supply." The lecture was divided into three parts which dealt respectively with induction motors, variable speed polyphase commutator motors, and variable-speed d.c. motors operated from an a.c. supply—the Ward Leonard, Ilgner, and other systems.

Prof. Magnus Maclean, Glasgow, recently delivered a lecture on the hydro-electric resources of the Scottish Highlands to a large audience in Edinburgh. Having described some of the existing water-power schemes, the lecturer dealt with the Grampian scheme, the object of which was to distribute electricity in bulk to districts in Inverness-shire, Forfarshire, Perthshire, &c. A description was also given of the small installations making use of the Highland streams, without battery or any storage, which were utilised for lighting private mansions and running machinery for agricultural purposes.

THE WORK OF THE ELECTRICITY COMMISSIONERS.

SECOND ANNUAL REPORT. *(Abstract.)*

(*Concluded from page* 114).

Fringe Orders.

Under the provisions of Section 6 of the Electric Lighting Act, 1909, the Commissioners have granted 58 orders permitting various authorised undertakers to supply electricity to specific premises outside the respective areas of supply, and a complete list of these is given.

Accounts, Returns, and Statistics.

The number of auditors holding appointments from the Commissioners in respect of the official audit of the accounts for the year 1921 of 187 company undertakers in Great Britain is 23, and a list of the names of the auditors is given.

Although it was anticipated that there would be some difficulty and delay in collecting, checking and tabulating the large volume of statistical information covering the operations of over 500 undertakers holding approximately 1,400 Orders and Special Acts, it is a matter of regret to the Commissioners that greater progress was not possible during the year under review. Apart from the undue delay of a number of undertakers in returning the completed questionnaire, there appears to have been, in many cases, a lack of appreciation of the importance of and necessity for accurate statistics. A preliminary examination of the returns revealed a large number of omissions and arithmetical and other errors, and it became apparent to the Commissioners that before arrangements could be made for the publication of an official volume containing the salient statistics, much time would have to be devoted to the completion and verification of the returns. These matters were still being proceeded with at the date to which this Report is made. A more satisfactory position has to be recorded in respect of the four-weekly returns of fuel consumption, units generated, &c., which all authorised undertakers are required to render to the Commissioners, and which are also submitted voluntarily by a number of railway and tramway authorities and by non-statutory undertakings owning generating stations.

During the year ending March 31st, 1922, the Commissioners received returns in respect of 433 generating stations belonging to authorised undertakers in Great Britain; in addition, voluntary returns were furnished to the Commissioners in respect of 103 generating stations owned by tramway and railway authorities or non-statutory undertakings. The total units generated during the year amounted to 4,884,666,038; the total amount of coal and coke consumed was 6,475,531 tons; and the total oil fuel consumed amounted to 145,541 tons.

Subscriptions to Associations.

During the year ending March 31st, 1922, the Commissioners issued 18 consents in respect of annual subscriptions to certain associations. In the majority of the applications relating to the Incorporated Municipal Electrical Association consent was also sought and given to the payment of the reasonable expenses of attendance of members or officers at conferences or meetings of that Association. The Commissioners also issued consents to the payment by certain local authorities of contributions towards the funds of district joint industrial councils.

Appointment of Inspectors.

The Commissioners appointed the following electrical inspectors during the year: Professor E. W. Marchant, D.Sc., in respect of the Chester Electric Lighting Order, 1890; Mr. F. J. Moffett, in respect of the Nuneaton and Chilvers Coton Electric Lighting Order, 1900; Professor William Robinson, M.E., M.Inst.C.E., in respect of the Melton Mowbray Electric Lighting Order, 1898; and Mr. A. G. Smith, in respect of the Wallasey Electric Lighting Order, 1897.

Transfer of Undertakings.

During the year, the Commissioners approved deeds transferring the undertaking authorised by the Bedworth and Bulkington Electricity Special Order, 1921, from the Midland Electric Light & Power Co., Ltd., to the Leicestershire and Warwickshire Electric Power Co.; transferring the undertaking authorised by the Litherland Electric Lighting Order, 1915, from the Urban District Council of Litherland to the Corporation of Bootle; and transferring the undertaking authorised by the Wigston Magna Blaby and District Electricity Special Order, 1921, from the Midland Electric Light and Power Co., Ltd., to the Leicestershire and Warwickshire Electric Power Co.

The Commissioners also approved of the acquisition by the Corporation of Bristol of the undertaking of the Keynsham Electric Light & Power Co., Ltd.

Charges for Electricity.

The difficulties confronting authorised undertakers during the year still remained of a serious character owing to the prolonged coal strike and to the severe depression in trade. Nevertheless, the relief in respect of maximum prices granted during the preceding year proved substantially adequate to the situation, as was evidenced by the comparatively small number of applications made to the Minister of Transport for further revisions of maximum prices. The Commissioners dealt in all with 50 applications, 12 being from company undertakers and 13 from local authority undertakers under the provisions of the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, and 25 being from company undertakers under Section 32 of the Schedule to the Electric Lighting (Clauses) Act, 1918, or corresponding provision. In two cases formal applications were withdrawn by the applicants. Particulars as to the recommendations eventually made by the Commissioners to the Minister of Transport on the 48 remaining applications are given in a table.

Multi-part Tariffs.

Further consideration was given by the Commissioners to the question raised during the preceding year by the British Electrical Development Association as to the limitations imposed upon authorised undertakers by the existing statutory provisions governing the methods by which consumers may be charged for electricity, and they came to the conclusion that in the interests of the further development of electricity supply to meet the various classes of demand now arising, a case had been made out for the amendment of the legislative provision which had hitherto presented an obstacle to the general adoption of multi-part tariff systems of charge. Provision for this was made in the Electricity (Supply) Act, 1922.

Overhead Lines.

There was an increase in the number of applications made by authorised undertakers for consent to the erection of overhead lines, 46 applications being dealt with by the Commissioners during the year, as compared with 34 applications during the preceding period. The Commissioners recommended the Minister of Transport to give his consent, subject to the power being reserved to the Minister to review the situation at the expiration of a period of five years, and subject also to the regulations of the Commissioners being prescribed upon the undertakers in respect of the proposed works.

Revocation of Powers.

Inquiries were initiated by the Commissioners during the period covered by the previous report with the view of ascertaining the position of all authorised undertakings as to which it was not definitely known whether a supply of electricity was being given, or whether compulsory works had been carried out.

After full consideration of the circumstances of each case the Commissioners recommended the Minister of Transport: To revoke 11 Orders in respect of the whole of the areas of supply in each case; to revoke one Order in respect of part of the area of supply; to revoke one Special Act in so far as its electricity provisions were concerned; and to defer consideration of the question of revoking three further Electric Lighting Orders and also four further Special Acts relating, *inter alia*, to the supply of electricity.

Compensation for Loss of Office, &c.

The first case under the Electricity (Supply) Act, 1919, in which compensation was claimed arose out of an arrangement approved by the Commissioners for a supply of electricity in bulk by the Corporation of Leeds to the Corporation of Morley. In consequence of that arrangement the generating station of the Corporation of Morley was shut down and partially dismantled, and claims were made by certain officials of the Corporation for compensation (i) for loss of office, and (ii) on account of being placed in a worse position as regarded conditions of service.

In accordance with the provisions of Section 16 of the Act of 1919 the Minister of Labour appointed a referee (Sir William Mackenzie, Kt.) to adjudicate in the matter, and the referee ordered certain sums to be paid by the Corporation of Morley.

Organisation and Staff.

The increased work indicated in the report was undertaken without augmenting the staff, as the Commissioners felt that it would be inexpedient, pending further experience as to the directions in which additional assistance was likely to be continously necessary, to incur increased expenditure. The actual excess of expenditure over income during 1921-22, including amounts estimated to be payable by and to the Commissioners but outstanding on March 31st, 1922, was £36,509, or a saving of £7,491 on the estimate.

THE PHYSICAL SOCIETY OF LONDON.

EXHIBITION OF SCIENTIFIC INSTRUMENTS.

(*Continued from page* 116.)

Cambridge & Paul Instrument Co., Ltd.

This firm's stand is always worth careful examination. Several new devices were exhibited, amongst which was a combined testing set (one of several made for Newcastle) mounted in a teak case, the over-all dimensions of which are 6 x 30 x 14 cm. It comprises a universal testing set, covering up to 600 V, 1,200 megohms, and 120 A; a capacity testing set with a range of from 0.005 to 375 microfarads; and a decade-pattern Wheatstone bridge which will measure resistances of from 0.01 ohm to 10 megohms.

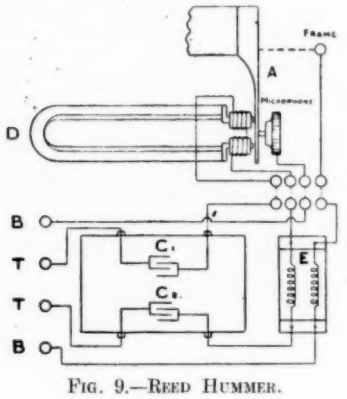


FIG. 9.—REED HUMMER.

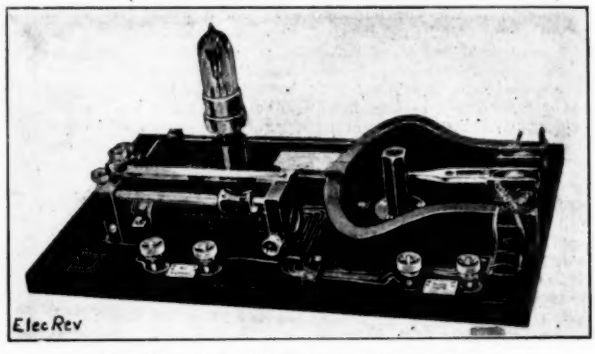


FIG. 10.—VALVE-MAINTAINED TUNING FORK.

Two hydrogen ion outfits were shown, one for research work in bacteriology, bio-chemistry and physiology, and the other for use in industrial processes. The first outfit consists of a potentiometer, which is a modified form of the ordinary slide-wire instrument in which all the moving parts, with the exception of the handles of the controlling switches, are inside the case, together with a galvanometer of the D'Arsonval pattern, lamp and scale, Weston normal cell and suitable electrodes. Readings are obtained directly to 0.1 millivolt and, by estimation, to within 0.01 millivolt.

The second outfit, self-contained and portable, comprises a potentiometer, with suitable electrodes, that consists of a pointer galvanometer of the unipivot type, an adjustable resistance to standardise the battery circuit with the galvanometer, a five-range switch to give steps of 200 millivolts and a fine adjustable resistance. The electrodes are connected to one pair of terminals, while a dry cell is connected to two other terminals on the instrument. The potentiometer is enclosed in a teak case having over-all dimensions 25 x 20 x 11 cm., and direct readings to 1 millivolt can be obtained.

The reed hummer illustrated in fig. 9 was designed by Mr. S. A. Pollock to produce oscillations of audio-frequency for use in bridge testing. The apparatus gives a pure note, and will run for hours without attention; it gives a suitable output for bridge work. The hummer has been approved and adopted by the British Post Office for telephonic measurements; it is embodied in the firm's trunk cable capacity test set. A tuned reed A, mounted on a heavy brass base, is fixed near to a permanent magnet D, which has coils wound on its pole tips; a microphone button is attached to the reed. In conjunction with a transformer E, two condensers C_1, C_2, which are fitted inside the instrument case, form a tuned circuit. The reed is made to vibrate, thus setting up a disturbance in the microphone and so producing a varying current through the magnet coils, which reacts on the reed and maintains it in permanent vibration. The hummer requires a battery of from 6 to 10 volts, the current taken being about 100 milliamperes. By connecting the terminals T to a screened transformer, an output circuit can be provided which, when connected to a bridge, prevents out-of-balance capacity effects at the salient points of the bridge. The transformer is supplied as a separate unit. The frequency of the hummer is approximately 1,000 cycles.

The valve-maintained tuning fork designed by Prof. W. H. Eccles and Mr. F. W. Jordan, illustrated in fig. 10, is somewhat similar to an electric bell in principle, but the contact is replaced by a three-electrode valve. A tuned fork is solidly mounted with its prongs between polarised windings on laminated cores carried on two electromagnets. One coil is connected to the grid, and the other coil is in the anode circuit. When the fork is vibrating an electromotive force of the same frequency as that of the fork is induced in the grid coil, and impressed on the grid of the valve. This variation of voltage on the grid gives rise to variations in the anode current of the same frequency. When this current is of correct phase relation with the motion of the prong of the fork it provides a vibro-motive force in traversing the anode

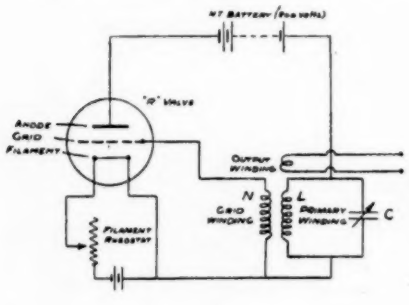


FIG. 11.—VALVE GENERATOR.

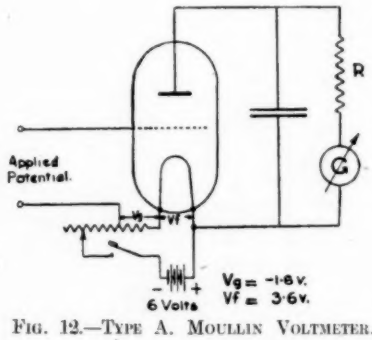


FIG. 12.—TYPE A. MOULLIN VOLTMETER.

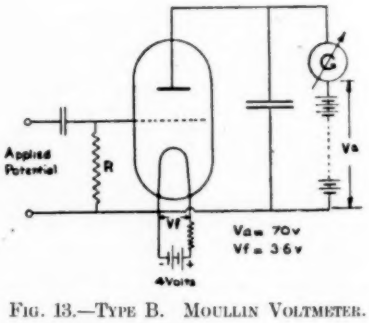


FIG. 13.—TYPE B. MOULLIN VOLTMETER.

The principle of the three-electrode valve generator, also shown, is indicated in fig. 11; L and C are the self-inductance and the set of condensers respectively which form the oscillatory circuit, the resonant frequency of which approximately governs the frequency

given to the oscillations. Closely coupled to L is a separate self-inductance N connected to the grid of the valve. A loosely-coupled tertiary circuit delivers the current to the external circuit. Two sets of windings are employed—one for frequencies from 300 cycles upwards (for use with a vibration galvanometer), while the other is for frequencies above 300 cycles (for use with a telephone) and gives a pure wave form; in addition, a laminated iron core provides a lower range of frequency that is useful for various tests. The frequency is varied by altering the capacity of the oscillatory circuit and to enable it to be continuously adjusted throughout the whole range three condensers are employed.

FIG. 14.—TYPE B. MOULLIN VOLTMETER.

Amongst the novel instruments having many industrial as well as scientific applications exhibited perhaps the most striking was the voltmeter due to Mr. E. B. Moullin, in which a triode valve is used as a rectifier and the rectified current, prdouced either by the curvature of the anode current/grid potential characteristic, or by the curvature of the grid current/grid potential characteristic, is used to measure the applied electromotive force by means of a galvanometer. For low voltages (0 to 10 volts), the voltmeter is about forty times as sensitive as the best commercial electrostatic voltmeter; it has an accuracy equal to that of a vacuum thermo-junction, and, as an ammeter, approximately thirty times its sensitivity. In addition, the instrument possesses the outstanding advantages that it absorbs no power from the circuit, its readings are independent of frequency, and it cannot be injured by an overload.

Type A instrument employs the curvature of the anode current/grid potential characteristic; a separate anode battery is therefore not required. The thermionic valve unipivot galvanometer and auxiliary apparatus are mounted in a case and, to use the instrument, it is only necessary to connect a 6-volt battery to the terminals of the filament and to apply the alternating electromotive force to be measured between two other terminals. It will be noted from fig. 12 that, in addition to heating the filament, the 6-volt battery provides a means of making the grid 1.6-V negative, so as to reduce grid damping to a negligible amount. This method of fixing the grid potential allows it to be made 0.25 V more negative than if a separate small cell had been used; it also obviates the risk of the calibration being upset by deterioration of such a cell. To ensure long life for the valve only 3.6 V is applied to the filament. The scale of the micro-ammeter is directly marked in volts, the standard range being 0 to 1.5 volts; readings can be obtained to 0.02 volt over most of the range. The effective resistance of the instrument at full scale deflection is at least 0.5 megohm, and the power absorbed at full-scale deflection is, in consequence, not more than 6 micro-watts; the decrement introduced by the instrument is, therefore, so small as to be almost negligible.

Type A cannot be employed either to measure an alternating potential superposed on a steady potential, or when the apparatus connected across its terminals does not form part of a closed conducting circuit. Type B (figs. 13 and 14) has been designed for this purpose.

The Galitzen seismograph is a new departure, a feature being the smallness of its dimensions. It consists essentially of a pendulum having a vertical or horizontal movement, according to the components that have to be observed. The end of the pendulum carries coils, which move between the poles of a pair of permanent magnets, and any movement thus creates an e.m.f. that is observed by a reflecting galvanometer, and is recorded on a photographic drum at a distance from the instrument.

(To be continued.)

THE HOT-WIRE MICROPHONE.

Its Application to Acoustic Problems.

By Major W. S. TUCKER, R.E., D.Sc., A.M.I.E.E.

(Abstracted from the Journal of the ROYAL SOCIETY OF ARTS.)

THE acoustic problems that arose in consequence of war requirements resulted in the formation of a small research organisation, supported by the Fighting Services and the Department of Scientific and Industrial Research, the work of which has led to the discovery of new facts and developments of general interest, some of which are referred to below.

The hot-wire microphone was essentially a war invention and has developed into an instrument not only for the detection, but also for the measurement of sound and vibratory motion.

It first consisted essentially of a box in one wall of which a small opening is made. When the explosive wave arrives at the opening—thereby creating a small excess pressure—a blast of air is projected into the box. In the path of the blast a very fine platinum wire grid is mounted, and heated by electricity to low incandescence. The blast cools the wire, lowers its electrical resistance, and so affect instruments such as galvanometers. The record obtained is an indication of the character of an explosion and also reproduces such variations in quality and intensity that enable one to identify the source.

The opening and closing of a door with sufficient suddenness makes the grid "blink" momentarily and shows how sensitive this microphone is.

Mere noise, however, does not produce an appreciable effect, as its selective character in sounds of all descriptions—traffic, conversation, rustling of wind in trees, and distant gun and rifle fire, ignores all but the low-frequency gun-fire. Records show the similarity in behaviour of two microphones of the same type when recording the same source (a distant shell burst) and their insensitivity to a revolver shot at five yards, while giving effects with a gun at 6,000 yards.

Distinctive records can be obtained from distant claps of thunder, and by means of three microphones sufficiently far apart, it is easy to locate the origin of the lightning flash. However, its sensitivity depends not only on the initial temperature and dimensions of the hot wire, but also on the size of the microphone chamber. For the best reproduction of impulsive sounds, it is of advantage to use a chamber of about 1 cu. ft. capacity and to make small holes or cracks in its walls to eliminate internal resonance.

Probably the thing that impresses one most is the instrument's surprising sensitivity to low frequency disturbances—disturbances which produce no effect on the human ear, since they are below our range of audition. Such an instrument might be harnessed to apparatus for the measurement of vibrations in structures. Vibrations are communicated to the human body as a result of the forcible projection of the blood through the arteries due to the pumping action of the heart. The shakings of the body are transmitted to a diaphragm whose resultant motion pumps the air from a closed vessel to a microphone, and the vibrating air cools the grid in such a manner as to indicate the nature of the body movements. Associated with the peaks of the recoil records so obtained, we are able (i) to identify certain movements in the blood, (ii) to note how these vary with individuals in an apparently healthy state, (iii) to show that the peaks are higher during inspiration than expiration, thus indicating a breathing cycle, (iv) to indicate how they vary when the body is treated with certain drugs, (v) to observe how they enlarge after exercise, and (vi) to show how they may suggest conditions of disease or of mental agitation.

This discovery opens up a field of research purely medical or pathological, and to be quite certain of a proper correlation of physiological and physical processes, it is necessary to understand thoroughly the meaning of the physical changes in the hot wire when subject to blasts of air, whether continuous, impulsive, or alternating in character.

The microphone wire is indifferent to the direction of the disturbing blast, since in both cases the wire is cooled, the resistance is diminished, and the record shows a succession of peaks entirely on one side of the zero line. However, if the grid is vertical so that the hot convection currents from the wire are perpendicular to the motion of the particles of the vibrating air, the resistance change has twice the periodicity of these vibrations; but if the grid is horizontal, the resistance change tends to be in tune with them.

The remarkable magnifying powers produced by resonance enable us to get sufficient disturbance with sounds of one predominating frequency to affect the hot wire. For accurate recording, resonance should be discouraged in the containing vessel by perforating its walls. If, however, the walls are left intact, the vessel with its microphone orifice has a very definite note of its own to which it responds with great vigour. Excited by the sound of the same musical pitch, the resonator produces intense vibration in the neighbourhood of the hot wire thus cooling it periodically. From known dimensions of the resonator, its magnifying power can be calculated, and it can be shown that resonance in a given case is confined to a very short range of frequencies, comprising about six per cent. of the mean frequency, so that it is only capable of responding to a range of about one musical tone.

The overtones to which it can respond are of high pitch, and are relatively feeble, thus making it the most selective type of resonator known.

The microphone may be tuned by altering the volume of the resonator or by altering the dimension of its neck—thus a larger volume or a longer neck would be employed for a lower note. In general, alteration of volume is the most satisfactory way of tuning. A microphone tuned to 512 vibrations per second, has one quarter the volume of one tuned to 256 vibrations per second, if the necks are equal.

One of the advantages of this type of microphone is its insensitivity to disturbing noises. Even tapping the microphone produces no appreciable effect, and the power to ignore shock makes it very useful for listening in places where the supports are subject to all kinds of accidental vibration. For this reason, also, the hot-wire microphone can be carried about a room, and will show by the galvanometer deflections the variation of intensity of sound at different points in the room.

If the microphone be mounted with its neck penetrating the wall of a cubical box, whose side contains a sliding door, a much better effect is obtained if the door be opened to a certain degree. The box itself becomes a resonator, and when tuned to the microphone note, the combination is extremely sensitive to a sound of the correct pitch. This phenomenon of double resonance in which the sound waves surge through the orifice between the two boxes has its analogy in the tuned circuits in a radio receiving installation. The combination exhibits not one, but two resonance peaks and gives a much wider range of tuning, while at the same time giving large magnification. The best effect is produced by such careful tuning that two resonance peaks of equal magnitude are obtained. So far this instrument is the most sensitive detector of sounds we have been able to produce and can easily pick up inaudible sounds within its range. We are indebted to Mr. E. S. Player for the discovery of a very efficient wind screening device, the ordinary "loofah," whose fibrous structure breaks up any wind impulses without obstructing the passage of air or of sound.

Its consistency of behaviour enables it to be employed for the accurate comparison of sounds of the same quality, for the ohmic change produced in the hot wire of the microphone is a direct measure of the intensity of the sound.

If we use a source of sound of a given pitch, we can find (1) How the transmission of such sound is affected by weather conditions. (2) How the sound is distributed in certain enclosures, such as rooms of different sizes and shapes, and how that sound is modified by opening windows or doors, or the distribution of the audience, or the furniture in a room. (3) How the sound is modified, magnified or distributed by the intervention in its path of trumpets, reflectors, or obstacles.

Thus we obtain data of considerable importance to meteorologists. The study of meteorological acoustics was developed at Kingsgate, near the North Foreland, admirably situated for working on the sirens of different light vessels. Doubly resonated microphones were employed, and we were able to obtain from the data thus supplied certain laws governing the conditions of audibility as affected by weather.

The distribution of sound in rooms is of great importance in architectural acoustics, and if notes of a definite pitch are selected, the duration of resonance can also be indicated by photographic records, and such records enable us to make measurements. By means of microphone, amplifier and vibration galvanometer, the distribution of sound can be exhibited to the audience, and also the manner in which the distribution of sound is affected by the movements of any person or article of furniture in the neighbourhood of the point at which measurements can be taken. The effects of sounding boards can also be demonstrated.

The directional effects produced by the intervention of trumpets, mirrors, and certain obstacles can be determined. Thus effects may be observed by placing the microphone in the neck of a trumpet and altering its direction relative to that of the incoming signal, or by placing the microphone in the focus of a concave mirror and rotating the latter. We hope in the near future to be able to measure sounds of a given pitch in absolute units of energy independent of that pitch, and to say what are the maximum ranges of audibility in terms of the average human ear. It is most important that as an outcome of this class of work, a unit of sound should be adopted which should be of value for commercial as well as for scientific purposes—similar to the candle power used in estimating sources of light.

The hot wire microphone has one distinct limitation—it is relatively insensitive to high-pitch sounds—but with the development of more sensitive apparatus for the measurement of effects, it will ultimately be available for this class of work also. Intensity of sound, as distinguished by the ear, will correspond to certain ohmic changes, which will be smaller and smaller as the pitch rises—but such ohmic changes, with the sensitive apparatus now at our disposal, should be easily measurable.

The work above described was carried out under the auspices of the Munitions Inventions Department, and the Signals Experimental Establishment.

WORKS PRODUCTION.

By G. H. NELSON, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE ideas contained in this paper are the result of experience, and the works system dealt with is one that is actually in operation.

In his introduction the author outlines the principal causes of the industrial depression through which the nation has been passing, and sets forth remedies for these, of which the most important is economical production. The latter can only be obtained by full co-operation, and it is the object of the paper to show how this can be secured. The heads of factories must be students of human nature, so that they will select men for executive positions who will in turn select and lead their subordinates to co-operate with other sections of the works.

To achieve success in the manufacture of machinery, especially electrical machinery with complexity and multiplicity of parts, the works organisation should be divided into distinct sections, each with clearly-defined functions. Experience has shown that a works sectionalised as follows has given very satisfactory results:—(1) design; (2) works superintendence; (3) technical process department; (4) rate-fixing and mechanical process department; (5) production department; (6) inspection department, and (7) costing department. It is quite impossible to find a man versed in the detail of all these branches, and the aim of the manufacturers should be to obtain the full benefit of accumulated specialised experience and to pass this down to the actual worker. The time is past when one man could run a technical business by doing everything, from buying to general supervision. The results of introducing the system about to be described were as follows:—The relation between the total value of the work in progress and the value of the monthly output of completed machines was reduced from 7 months to 4½, representing a considerable saving in capital and interest; the average time of manufacture of a certain size of machine was reduced from 22 to 18 weeks and that of other sizes, relatively; the number of machines overdue was reduced two-thirds; the number of defects arising during manufacture on various operations has been reduced two-thirds; the accumulative effect has reduced the cost of manufacture by a considerable amount.

Concerning design, it may be said that the people in the works cannot be expected to know the technical details which the designer has in mind, and they should therefore be told as much as possible. The principle of co-operation should be applied here to its fullest extent. The design of each part of a piece of apparatus should be considered at a meeting of the

designer, the manufacturer, and, if necessary, the salesman (who should know the requirements of purchasers), before it is finally manufactured. Shop drawings should be clearly dimensioned and limits of accuracy given. The various kinds of surfaces should be clearly marked.

The most important consideration under the heading of "works superintendence" is that of labour. The majority of the workers are reasonable men, but they lack the knowledge which would enable them to consider the problems with which they are faced. Education is of the first importance. The training of apprentices should include lectures on economics and they should not be left to pick up a trade by their own resources. In the works with which the author is associated the apprentices are given lectures in the employer's time, not only upon such subjects as fitting, turning, and winding, but also upon the rudiments of rate-fixing and costing. The author considers that these facilities should be extended to the older workmen. There is also a necessity for the inclusion of economics in the curricula of universities and technical schools. The relation between capital and labour, costing, time-keeping, and the absorption of overhead expenses should be dealt with; when men enter industry they seldom have to apply solely technical knowledge. The works committee is the most effective way of establishing confidence between the management and the men. It is the most satisfactory channel for bringing the management's views on all sorts of questions before the workers. It also enables the management to obtain the workers' views and makes them feel that they are being consulted upon matters in which they are directly interested. The author attributes in a large measure, the success of the system outlined in the paper to the Works Committee. Foremen's meetings also possess a special value; the men are made acquainted with economic and managerial problems which otherwise they would not know.

The fear of unemployment is a great brake on production. This gives the worker the feeling that by exerting extra effort he is only completing more quickly the small amount of work that is available, and it is impossible in such circumstances to get from him his maximum effort. It is not easy to convince him that he is making the cost greater and therefore rendering it more difficult to obtain further orders. It is thought that the creation of a fund during times of good trade to tide over periods of depression would remove this fear of unemployment. To produce this, the author suggests that this might be done in a "payment by results" works in such a way as to be entirely dependent upon the workers' efforts, but should be contributed to by both the employer and employé. In the engineering industry agreements already exist by which a piece-worker of average ability must be able to earn 33⅓ per cent. bonus. Most workers earn considerably more than this. It would therefore be feasible for the employer to say that for every 1 per cent. earned by the worker over the 33⅓ per cent., up to 50 per cent., he would give a fixed sum per shilling to the fund, provided that the employé would also give a similar amount; and further, for every shilling over 50 per cent. bonus the employer would give a further extra contribution. If deemed advisable, the money could be applied to old age and sickness benefits, and it could be administered by the works committees or district committees.

The technical process department is obviously necessary in view of the fact that many of the problems connected with the manufacture of electrical machinery cannot be left to the shops to solve. Though there are often several ways of getting the same ultimate result, there is only one way which is the most efficient and cheapest. It is the duty of the process department to study these various problems and to issue such instructions as are necessary to assist those concerned. Records must be kept of various process specifications to enable newcomers to proceed on the same lines. This department also issues the necessary specifications to buyers. In the paper specimens of actual specifications are reproduced.

The selection of the personnel of a rate-fixing and mechanical process department requires careful attention. For products of comparatively simple design and construction rate-fixers who have graduated from the ranks of the workmen without any special training will be competent, but in the case of the more complex apparatus the rate-fixers should also possess a thorough knowledge of the functions of the multifarious components. In order to take full advantage of the machines, tools, and improved methods evolved by the mechanical process engineers in collaboration with the tool drawing office, it is desirable that the department should consist of two distinct branches. One branch should deal almost entirely with the time studies of the feeds and speeds to be obtained by improved methods and appliances, and should thereby supply data to the other branch, consisting of the process engineers. In this way a definite basis for piece-work times is arrived at. The process department compiles a process sheet for every item for which a drawing is made, and this specifies, among other things, the description of the machine for which the part is required; the minimum number of items to be manufactured at a time to enable the time per item to be adhered to; the machine tool to be used; the hourly rate of the machine tool; the class of labour to be used on each operation; the rate of labour to be used; "war" allowances; the factory expense; the total cost of labour and factory expense; and the sequence of operations. A typical process sheet is given in the paper. Disputes regarding the time allowed are settled by the time-study men for the department, and the operator is permitted access to the data upon which times are based to point out errors. If the special circumstances of a job necessitate it, the time for the job is altered, but the processed time is allowed to stand. Process sheets are issued as soon as possible after the completion of a drawing, so that the piece-work time is fixed well in advance of the operation. The process department is able to keep the purchasing department acquainted with the relative merits of materials and aid it in securing the best and cheapest supplies. The department also aids the estimating department by supplying accurate data, and is able to advise when reductions can be made owing to improved efficiency. Piece-work times being based on the best machine tool, it is possible to calculate losses on less efficient machines, showing whether the latter are worth retaining in service. Process sheets are sent to the costing department to enable differences to be checked; they also enable the production department to deduce exactly the time required to manufacture any piece of apparatus. The process engineers frequently find when processing a part that an alteration in design will effect a reduction in cost without interfering with the functions of the particular part.

The production department should be directed and controlled by the works manager, through the chief of the department, to ensure that it is not systematised beyond practical and commercial limits. The capacity of the shop is fixed by the works management in conjunction with the requirements laid down by the sales organisation, and the capacity fixed by the rate-fixing department, and the main shop programme is prepared. In this programme the shop's capacity is satisfied with actual jobs and the time they will occupy in each department is fixed. Each month is laid out similarly and the commercial department is advised by the production department of forward requirements in good time to keep the shop fully employed. If the orders received exceed the shop capacity, the fact is revealed in good time to enable steps to be taken to deal with it by extending the works, obtaining outside help, or increasing the working hours or delivery periods. The main programme is based on a machine production chart, which shows in a clear manner the time required to complete each part of a machine, taking into account the obtaining of material besides the actual manufacture. The dates being fixed for each part of the job, a system of "urging" is brought into operation. By this means the manufacturing information (including drawings and specifications), material, and work in the different departments is hurried up. The "urging" is done on a weekly basis. For sake of convenience the production department is organised into two sections, one section handling specification sheets, the main production programme, obtaining materials for outside suppliers through the purchasing department, and all work inside the office, and the other dealing with materials after receipt in the shops, and the production generally in the shop. The closest co-operation is essential between these two sections. The foremen are provided with weekly production lists, giving instructions for four weeks; these are based on the main production chart. These production lists are handled by the shop clerk, whose duty it is to keep the foremen advised where the material is after receipt from the suppliers, and to get out the necessary drawings and tools to enable the work to be proceeded with at the right time. Production meetings are held weekly, when the shop superintendent, buyer, production chief, and foremen are present, and details of progress, &c., are discussed. A return is made to the works manager each week giving the reasons for the non-completion of outstanding items. For a certain works employing 700 hands, the production staff consisted of: one chief, two assistants, three clerks, and one typist, exclusive of four foremen's clerks.

It has been found of the greatest advantage to arrange for inspection and testing as the manufacture proceeds through the works. This facilitates the shipping of the job by the avoidance of expensive repairs. The author has found it necessary to lay the responsibility for the testing and inspection of raw materials upon the inspection department, but it is very important to leave to the foremen the real responsibility for the quality of the product. It is essential that the inspectors should co-operate with the manufacturing section to improve the product and avoid mistakes, rather than criticise. The number of inspectors depends on the class of work that has to be dealt with, and as a rough guide the author has found the following proportions to be satisfactory: Large machine section requires one inspector to 60 hands; small machine section, one inspector to 70 hands; large assembly section, one inspector to 45 hands; small assembly section, one inspector to 35 hands; large winding section, one inspector to 40 hands; coil and insulation section, one inspector to 40 hands. The cost of these represents approximately 0.7 per cent. of factory cost of output, and the results show a large decrease in the number of defects in the finished machines.

The costing department is not a spy upon the manufacturing department, but a useful and constructive portion of the manufacturing organisation. Costing can be conveniently divided into two sections: direct labour and materials, and factory overhead expenses. The costing department must be

able to provide operation costs as quickly as possible after an operation has been carried out, so that the actual cost can be compared with the planned process, and to make this scheme operative the mechanical process department must provide a complete detailed list of the planned operations. The most important point about a costing system is that it must not give either too little or too much. If the former it becomes useless because the information is incomplete; and if the latter, more money is being spent than the value obtained for it. In the author's opinion a machine-rate basis is the only sound way of costing factory overhead expenses. A percentage on labour is wrong owing to the variations in rates. With the majority of the machine tools at the author's works the machine-rate basis is taken as 40 hours per week. The machine-rate basis is obtained by allocating a portion of the fixed charges (as rates, rents, taxes, depreciation, &c.) for the floor space occupied by the machine and the surrounding space necessary for storing the raw and finished product. Power charges are arrived at by taking the actual power measurement of the machine.. Tool charges are obtained by estimating the value of the tools used in a definite period and employing this as the basis for an average hourly cost. Hourly charges are arrived at for depreciation, general shop labour and materials, operation of cranes, &c. These costs are carefully watched, the responsibility being divided between the foremen, the works superintendent, and the management. By this method a more direct interest in the efficiency of the department is created, because the foreman realises that he has something which he is able to control. The foremen should be kept acquainted with the variation of labour and factory expenses; they should be looked upon as the managers of their own departments.

To illustrate the relation between output and costs of production the author assumes the case of a factory with a normal output of 1,000 machines a year, and shows how organisation can improve production and increase the profit and, upon the other hand, how bad management can lower production and cause a loss. The results occur principally through the factory expenses remaining constant whatever the production, while selling expenses vary but little. The author considers that the principles outlined in the paper might be applied outside the manufacturing industry. For instance, a power station engineer increasing his plant can lay out a programme to ensure that his orders are placed at the right time, and so avoid capital lying idle and plant delivered before it is required, and delays in completion.

The author, in conclusion, expresses his thanks to the Metropolitan-Vickers Electrical Co., Ltd., for permission to describe the company's Sheffield works. There are two appendices to the paper. One is a process specification for moulding mica to end rings for large rotors, and the other is a purchasing specification for asbestos millboard.

Discussion in London.

The paper was read by the author at the ordinary meeting of the Institution on January 18th, and in the ensuing discussion

Mr. H. Mensforth, C.B.E. said that he thought Mr. Nelson adopted too patronising an attitude towards the employés and they would probably resent it. Economics was mentioned very frequently, but he (the speaker) did not consider that the employer was the proper teacher. The workers were not so ignorant of economies as the author suggested. The question would be asked "What happens to the difference between the factory cost and the selling price?" It was possible to effect a saving on material. Productive labour did not constitute the largest part of the factory cost; too much attention was paid to wages when it came to considering the reduction of costs. Although correct estimating was of fundamental importance, the estimating department was not mentioned in the paper. The suggested sinking fund might be sound, but it appeared that it would come entirely from the workmen's efforts. The undertaking between employer and employé stipulated that the piece-worker must be able to earn 33⅓ per cent. on his basic rate. The rate paid should be an agreed rate and all prices should be subject to that agreement. What was the machinery which would operate when the agreement was abandoned? The speaker did not think that the overhead expenses would show so little variation with varying production as the author had stated. Works committees were valuable in numerous ways, but the majority failed because the employers limited their scope. Anything which interfered with efficient running —any grievance—could legitimately be considered by these committees. Production per man was greater in the United States because the men were better fed with work—jobs were organised further ahead than in this country. Here the workman did not know what his next job would be and was tempted to take longer over the work in hand. The production and the means of production were two separate responsibilities which should be in separate hands.

Mr. G. Hurford said that although the management might explain its difficulties to the foremen, it was more important that the foremen should explain *their* difficulties, which were probably greater than those of the management. Surely the selling cost of 500 and 1,000 motors would not be the same in each case?

Mr. W. F. Higgs considered that the complexity of production could be considerably lessened by greater specialisation. He thought that "ca' canny" was the responsibility of the management. He knew of a firm similar in all respects to another which was able to increase its production by 50 per cent. above that of the other by reorganisation. The speaker considered that the case for piece-work was a strong one. Insufficient attention to drawings was the cause of a great deal of trouble. The design department should not consume a third of the time required for delivery, and then the work of the production department would be facilitated. He asked the author to express his opinion upon the fixing of piece work rates on time rather than money.

Major K. Edgcumbe thought that the teaching of economics was very essential, as the average workman had very little knowledge in that direction; otherwise works committees could not function satisfactorily. These talks should not be termed "lectures on economics" or an audience would never be secured. He did not agree with the figures given as selling costs for varying production.

Mr. J. R. Cowie said that no direct reference was made in the paper to the stores department. If this department was behind with the material, a job could never be completed to time even if 99½ per cent. of the material was available. There should be definite co-relation between the process or progress department and the design department and drawing office, and these should be in direct co-operation with the stores department; this was not clearly shown in the paper.

Mr. F. Tremain said that in the course of his experience as an inspector he had been able to make many suggestions with regard to organisation which had increased production. He thought that the training at technical colleges was too narrow. He had known men who were excellent technically, but absolute "babes" in so far as business was concerned.

Mr. R. S. Allen stated that there was no reference in the paper to the purchasing department—a very important branch. As regarded rate-fixing, this was done by the planning department in the early stages of the job—how was the price affected by changes at the machines? He asked the author to give the percentage of "black-coats" to workmen. The labour sinking fund was admirable in conception but very difficult of application. "Ca' canny," he thought, was due to the fact that immediately slackness in business occurred, men were discharged, and they could not understand the reason for it. The speaker asked whether the process sheets were standardised or made out separately for each job.

Mr. H. Brown, referring to the education of workers, asked if the Institution was aware of the way facilities for education had been curtailed. He made special mention of the Board of Education science examinations and those of the City and Guilds Institute. He considered that this false economy gave the worker no incentive to better himself, and the works suffered.

Mr. H. W. Richardson also agreed as to the necessity for education. He said that the questions asked were always the same, and he expressed the opinion that they were put into the workers' minds by "agitators." He thought that distribution costs should have been considered in the paper, and he also regretted the omission of the stores department which, he said, should have ample room to allow for the easy moving of stores. Transport within the works was of great importance, and in this connection electric trucks and better crane facilities were to be recommended. The grouping of machines of one class was not advisable.

Mr. W. E. Burnand said that success in any business, large or small, lay in the fullest possible realisation of the possibilities. He thought that "one-man" businesses could be as successful as larger concerns without elaborate systems. The value of keeping records was enormous ,but they should be readily available.

In reply to the discussion, Mr. Nelson said that Mr. Mensforth's contentions as to the difference between factory costs and selling price were beyond the scope of the paper; it dealt only with works production and not with selling and distribution. He could not agree that workers would not accept their employers' views on economics. The estimating department was a part of the mechanical process department. Specialisation was very necessary—the American way was often to ignore suggested departures from standards and get on with the job on the standard lines. Piece-work was better than day-work because with the latter the best men slowed down to the level of the slackest. All piece-work jobs in his works were based on time not money. Buying was done in conjunction with the production department, and the drawing office was also under the control of the production department. Changes in piece-work rates were looked after by the time-study department. The inspection department did not wait until a job was completed, but examined it at the machines stage by stage. He agreed that there should be greater educational facilities for the older men. Works transport was included under shop supervision—it was not important enough to be treated separately. In conclusion, he said that even in "one-man" businesses it was necessary to take advantage of the expert knowledge found in the shops.

THE HIGH COST OF ELECTRICAL INSTALLATIONS.

A PAPER on this subject, by Messrs. W. J. Revell and F. T. Alldread, was read before the NATIONAL ASSOCIATION OF SUPERVISING ELECTRICIANS, on December 12th. Mr. W. E. Highfield, the president, occupied the chair, and, in opening the proceedings, said that the question of cost of installations affected the industry more than any other. Mr. Revell was unable to attend, through illness, and the paper was read by Mr. Alldread.

The paper, in the first place, dwelt on the fact that in many other countries electricity was extensively used in even artisan dwellings, whereas in this country it was the exception rather than the rule. Electricity was still regarded as a luxury because of the high cost of installation. The chief factors in the cost of electrical installations, in order of their importance, were (*a*) design of materials and lay-out of the installation; (*b*) prices of manufactured materials and articles; (*c*) labour; (*d*) establishment of overhead charges; and (*e*) contractors' profits.

Dealing with the first, the authors said it was for the contractor or his engineer to determine what particular system was best in the particular circumstances. Special designs of apparatus and accessories prevented mass production and reduction of manufacturing costs. Every effort should be made to use only such articles as complied with B.E.S.A. standards. Manufacturers appeared to make only their highest-priced wares in compliance with those rules, and contractors were thereby encouraged to purchase the cheaper non-standard articles, very often with false economy. It was vitally necessary to eliminate all devices and methods which were not necessary to ensure reasonable durability and freedom from danger.

With regard to the prices of materials and apparatus, the authors said that the greater portion of the manufacture of the materials, &c., essential to the industry was in the hands of powerful rings or combines. Were these rings necessary to the contracting industry, and with what beneficial results were rings formed? Ostensibly they were formed to produce a high standard of efficiency, but it would be uncommercial to expect that any number of manufacturers were going to pool their interests for this object alone. If so, why were articles supplied by "ring" firms more costly than the same class of goods obtainable from firms in competition with them? Also, the products of the rings could be bought for export cheaper than for home use. If it were the case that in foreign and colonial markets the rings met competitors as formidable as themselves, and only by getting down to rock bottom could they compete, then rings should be abolished and healti competition substituted.

The cost of labour in connection with installations was undoubtedly the most speculative section of contracting. It was not chiefly to rates of wages that the successful contracting engineer looked to materially lower his costs. Much could be done by good organisation. It was possible for an engineer, without altering rates of wages, to reduce labour charges anything up to 50 per cent. The foreman's co-operation with the office staff was essential. Before actually commencing the work on an installation, it was better to map out the whole job, then to requisition all the materials necessary, give the fullest possible information, and indicate approximately when the materials would be required.

Under the heading of "Establishment or Overhead Charges," the authors included all outgoing expenses other than those directly chargeable to materials and labour, and covered such articles as rents, staff salaries, advertising, outlay on plant, tools, &c. After deprecating the fact that some firms looked upon the technical staff as a necessary evil, and reduced it as much as possible, which resulted in lack of technical preparation and supervision of jobs, the authors stressed the importance of a contractor having his own workshop. The necessity for contractors to run showrooms was also emphasised; whereas a manufacturer could not give unbiased opinions to clients in the selection of apparatus, the contractor could.

There were many ways of increasing contractors' profits without raising prices of proposed contracts. The practice of the contractor carrying out the installation, and the customer securing his fittings, &c., through other channels, was condemned, because, not only did it rob the contractor of his legitimate gains, but increased the prices for installations, thus reducing the demand. If apparatus were bought from the contractor he could work at a lower rate of profit for the whole job.

The PRESIDENT, opening a discussion, pointed out that it was the small things that told, and if the costs of installations in smaller houses could be reduced it would send up the industry by leaps and bounds. He believed that the greater use of electricity in the smaller houses on the Continent was due to the fact that the towns and villages concerned had not passed through the gas age, and also that not so many fittings were used. He considered that the design of electrical fittings was bad. If a first-class designer took the trouble to get out half-a-dozen good fittings, he would produce something with about one-tenth the number of parts, and at about half the cost. But the remedy lay largely in the hands of the Association. As to the lower export prices of the combines as compared with home prices, he believed it was because there was control only in the home market. Of course, the manufacturers had to compete with the rest of the world, and naturally had to quote lower prices abroad, especially having regard to the problem of the exchange. With regard to labour, he wondered whether a premium system was possible, *i.e.*, the foreman taking work on at contract prices. With a monetary interest in the job it would be done quickly and well.

Mr. T. H. WINDIBANK said the authors had not mentioned supply authorities. If a contractor spent a couple of days getting an order, he had to spend another three persuading the power suppliers to act. He referred to many instances in which the absurd rules of supply authorities had forced up the cost of installations.

Mr. F. W. SMITH defended the "rings," and said that without them the electrical industry would be in absolute chaos. If there were nothing to protect the prices of articles manufactured, there would be various classes of manufacturers "cutting each other's throats," which was the case in the contracting industry. Mr. Alldread had talked of the collective action of contractors, at the same time condemning the same kind of thing on the part of manufacturers. The speaker referred to the good work done for the industry by the B.E.A.M.A. He could not agree that a contractor should be allowed to control all the apparatus which a manufacturer manufactured.

Mr. R. W. WHITLEY said that, as 90 per cent. of the jobs secured by contractors were secured under conditions of severe competition, it seemed that the consumer was not paying too much for installations. Did the paper mean the high cost to the consumer or to the contractor? As to different standards of installation, he knew of one firm of contractors who had three standards.

Mr. P. ROSLING also defended the "rings," and outlined the history of the Cable Makers' Association; whereas, in 1900, cable makers were "cutting each other's throats," the trade was now standardised as to quality. Again, cable makers now were able to make a small profit, and to use some of it for research, which was a necessity to the country. As to export prices, but for foreign trade the English prices would go up (because overhead charges would be greater), although the prices were lower abroad.

Mr. ALAN KIRK said that an engineer must be a commercial man. As to quality of material, he criticised the practice of contractors, when buying, to consider price only; if they considered also, not only the quality, but the service, they would get a better judgment of the value of an article. A contractor should get accessories on which he could reduce labour. Practically every accessory on the market could, with very small modifications, be altered to reduce the labour in fixing and connecting the wires. If a contractor had an order direct from a client he must act as consultant, and, as such, must be able to know the material required absolutely accurately.

Mr. A. J. STILING thought it nearly time that contractors combined, not to keep up prices and prevent competition, but in order to buy outside the rings and combines, and so create competition. Why could outside firms turn out similar articles much more cheaply? That showed there was either something wrong with the rings' prices, or that their enormous sales organisations tended to keep up costs.

Mr. MOORE said that many cable firms outside the ring were doing well in this country, whilst some of those inside were not. With regard to a remark that cables could be bought from outside firms at lower prices, to comply with all tests, he pointed out that cables could be made to answer almost any initial test; for rubber cables he did not think there was any initial test which was a proper criterion of their quality, and the only guarantee of lasting quality was the reputation of the manufacturer.

Mr. STONE said he had noticed in Germany that the installations in widely varying types of buildings were much of the same type. We in England, demanded certain standards of work for certain kinds of buildings. There could be no question that the work which had to be put into some of our large buildings was not needed, and it was necessary to reach a standard which would bring cost down. This should be arrived at by the Association and others to enable the contractor to put forward to the working man a standard job at a standard price.

Mr. P. MILLNS pointed out that the many types of apparatus which manufacturers had to produce tended to raise prices, and pointed out the absurdity of supply companies' regulations..

Mr. ALLDREAD, replying to Mr. Smith, agreed that the majority of the larger manufacturers employed engineers as salesmen, but did not agree that the majority of the salesmen on the road were engineers. With regard to "rings," he was surprised that he had not heard why it was still possible for a number of firms to manufacture cables at 10 or 20 per cent. less than others.

BRITAIN'S INTERESTS IN BRAZIL

(With Statistics of Electrical Imports).

Official View.

It is gratifying to learn from H.M. Commercial Secretary at Rio de Janeiro (Mr. E. Hambloch) that in spite of many adverse circumstances Great Britain has improved her position as an exporter to Brazil. Such was the situation at the end of September last, at which date Mr. Hambloch closed his report. (Department of Overseas Trade, 1s. 9d.) Since then the same tendency has been noticeable, and indeed has been accentuated, not only by the success of the British engineering exhibits at the Rio exhibition, but also by the visits of a number of business men interested in the cotton and other trades.

The adverse circumstances to which the report refers are the depressed market for Brazilian produce, predominantly coffee, the consequent low exchange value of the milreis, and the preference granted by the Government at Rio to certain United States and Belgian products. As will be shown further on in this article, whilst the favourable treatment accorded to two of our competitors has not exercised a very great direct influence on our trade in the particular articles involved, it has tended to discourage our exporters generally from making special efforts in the Brazilian market.

Yet the Commercial Secretary finds that many British manufacturers are fully alive to the great possibilities existing there. Personal visits and investigation are, he says, becoming more frequent while the variety and number of trade inquiries received at the Embassy have shown a steady increase. During the period covered by the Commercial Secretary's report (1921 and January to September, 1922) the United States has lost ground in Brazil. Importation in 1922 has been considerably restricted by the low rate of exchange, and there has been a substantial export balance. This export balance, it is pointed out, is by no means sufficient to cause any considerable rise in exchange owing to Brazil's large financial commitments abroad.

Hint to Capitalists.

On the subject of capital investments H.M. Commercial Secretary does not hesitate to recall that in the early part of 1922 the Federal Government issued an official communiqué to the effect that it was not and could in no way be held to be responsible towards foreign investors for loans made to the various States and Municipalities in Brazil. It is well to bear in mind that there is no local appeal to the Federal Government in cases in which borrowers do not fulfil their obligations in such cases.

British engineers who are interested in South American developments will doubtless bear in mind the apparent inclination of the Brazilian Government to give every protection to the country's metallurgical industry. Already a number of new industries there have, to a large extent, profited by a restriction in importation. Local interests engaged in Brazil's manufacturing industry are sufficiently strong to ensure ample tariff protection, quite apart from the fact that all shades of political opinion are protectionist. Foreign capital engaged in national industries is, in Mr. Hambloch's opinion, amply guaranteed and earns a relatively high rate of interest. The progress made so far in utilising the large deposits of iron in Minas Geraes consists in the production by the Usina Esperança of 9,990 tons of pig-iron, and by the Usina Miguel Burnier of a daily average of 12.5 tons. The installation at Ribeirao Preto is rapidly nearing completion. With regard to the activities of the Anglo-Brazilian Iron and Steel Syndicate, the report say that further negotiations are pending with the Federal Government respecting the acquisition of hydro-electric power for the proposed iron and steel works. The Germans are reported to be showing considerable interest in metallurgical developments in Brazil, the Stinnes and Thyssen groups being, it is said, notably active.

The Commercial Secretary's report gives particulars of Government decrees affecting railway, port and public works developments, together with a translation of the recent detailed report made by the Minister of Traffic and Public Works to the President of the Republic.

The Preference Question.

The British Chamber of Commerce in Brazil has recently examined the question of the lack of British preference in Brazil's tariff policy. With regard to the American goods which enjoy favours, the Bulletin of the Chamber points out that the leading preference given to the United States—that upon wheaten flour—has not prevented the Argentine from retaining her Brazilian market. As to the other American articles which enjoy a 20 per cent. rebate of duty, several are articles in which the United States has an easy predominance in Brazil, apart from any such preference, while several others are either unimportant lines or are articles which, in spite of the preference, are chiefly imported from other countries. None of these preferences, it is added, is such as to give a monopoly. On the other hand there are a number of lines in which the United States has almost monopolised the trade without any tariff assistance whatever.

Of the preferences given to Belgium the effect has probably not been very great if costs, exchange and other conditions are taken into account. Certainly some of the leading lines of Belgian export to Brazil do not enjoy a tariff advantage. Whilst, however, the direct effect of these preferences has been little more than to decrease slightly British sales of cement, paint, varnish, weighing machines, &c., the indirect influence has been great. In the minds of British merchants a feeling has been raised against the Brazilian tariff system as a whole.

The truth is that the scale of duties, which was adjusted long ago on a 16d. basis, has become very unequal to-day, not only because of the lower exchange, but also because changes in manufacture have produced a condition in which many cheap articles must pay heavy *ad valorem* rates as being "unclassified," while the old classified goods pay a more moderate rate fixed per unit or by weight. This necessity for revision of the tariff is fully recognised in Brazil, and the work of tariff reform is proceeding, but its progress has been slow because of the many conflicting interests involved in every separate article of the tariff.

IMPORT TRADE OF BRAZIL.

The following figures showing Brazil's imports of electrical and allied goods have been taken from the official returns. The corresponding figures for 1913 have been given for purposes of comparison, and notes of increases or decreases added:—

	1913. Metric tons.	1921. Metric tons.	Inc. or dec.
Dynamos and electrical generators.—			
Total	1,000	750	− 250
From Great Britain	100	50	− 50
„ United States	350	450	+ 100
Electric motors.—			
Total	1,500	1,600	+ 100
From United States	500	550	+ 50
„ Great Britain	200	100	− 100
„ Switzerland	150	100	− 50
Insulators.—			
Total	2,200	3,300	+ 1,100
Electric lamps.—			
Total	250	150	− 100
From United States	75	50	− 25
„ Great Britain	10	5	− 5
„ Netherlands	15	30	+ 15
Transformers.—			
Total	1,000	750	− 250
From United States	800	600	− 200
„ Germany	150	120	− 30
Copper wire, insulated.—			
Total	1,000	600	− 400
From United States	750	350	− 400
„ Great Britain	50	10	− 40
Electric cable.—			
Total	2,600	2,000	− 600
From United States	500	1,000	+ 500
„ Great Britain	1,250	250	− 1,000
„ Germany	600	150	− 450
Telegraph and telephone posts, bridge and fence material.—			
Total	795	705	− 90
Machinery and apparatus, not textile or agricultural.—			
Total	28,000	14,000	−14,000
From Germany	10,000	4,000	− 6,000
„ United States	5,000	5,000	—
„ Great Britain	8,000	2,500	− 5,500
Engines, oil.—			
Total	550	440	− 110
Engines, steam.—			
Total	260	20	− 240
Pumps.—			
Total	1,500	500	− 1,000
From United States	500	250	− 250
„ Great Britain	300	150	− 150

	1913. Metric tons.	1921. Metric tons.	Inc. or dec.
Total	18,000	10,000	– 8,000
From United States	1,000	2,300	+ 1,300
,, Germany	6,000	2,000	– 4,000
,, Great Britain	5,000	2,400	– 2,600
,, France	4,500	1,500	– 3,000
Machinery, electrical, n.o.e.—			
Total	2,700	2,600	– 100
Cranes.—			
Total	3,000	2,000	– 1,000
From Great Britain	1,600	1,250	– 350
Boilers.—			
Total	3,200	2,000	– 1,200
From Great Britain	2,000	1,000	– 1,000

ELECTRICITY AND SPRING CLEANING.

A LECTURE was given on January 19th by Mr. H. T. Young, of Messrs. Troughton & Young, at an Electrical Development Association Salesmanship Conference. Mr. R. S. DOWNE, of the Brompton and Kensington Electricity Supply Co., was in the chair, and announced that it was the intention of the E.D.A. to arrange for a further series of conferences next session, when different methods of treatment would be adopted. He hoped there would be four or six series of conferences running simultaneously in different parts of the country, because it was essential that this should be a national movement. On the general question of the use of domestic electrical apparatus, he said it was amazing to see the manner in which the American contractor was able to induce his customers to adopt electrical apparatus, whereas in many places here, 50 per cent. of the consumers on the mains used electricity only for lighting.

Mr. YOUNG, who took as his main theme the opportunity afforded by spring cleaning, said that there were two seasons of the year when special plans should be made—the spring and late autumn. He, however, only dealt with springtime. Carefully prepared plans should be made immediately after Christmas, and he suggested that a limited number of householders should be selected and dealt with continously, rather than to make a spasmodic jump at a large number. These householders should be divided up as follows:—Consumers with whom business was being or had been done; those who were already using electricity for some purpose; and those who were not using electricity at all. Letters should be sent out in the early part of the year and followed up in an organised manner, and he suggested that the E.D.A. might prepare standard letters for the purpose. Wherever possible, demonstrations and exhibitions should be arranged, and for this purpose there must be co-operation between all sections of the industry. There was an enormous amount of energy wasted in useless competition throughout the industry, from manufacturers downwards. The repair and maintenance staffs could be made into good salesmen by tactful coaching at special staff conferences, which should take place at least once a month, and at any rate, men who could not rise to propaganda work would be prevented from discouraging the use of electricity for domestic purposes, as they so often did through ignorance. Prices of houses, decorations, wiring, electricity, and other things were down, and thousands of people, who had waited for this for eight years, would be moving into new houses or having their own renovated this spring; there never was a better opportunity for a big push in the domestic electrical industry, which could be accomplished by combined and concerted action by all branches of the industry under the banner of the E.D.A.

Mr. Young outlined the position in relation to the consulting engineer, the architect, the builder, the householder, and the tenant, with all of whom the contractor had to come into contact. In the case of the consulting engineer, he, of course, was always working for the development of the industry, and with him, the salesman had to watch questions of price and service. The architect was more difficult, because many of his opinions were based upon old apparatus. He had been too much neglected by the electrical industry in the past, and the suggestion was made that a special committee should be set up by the E.D.A. to consider the best methods for keeping architects in touch with electrical progress. The builder often required similar treatment to the architect, whilst the landlord could best be approached by urging the saving to be made in the cost of decoration and the generally increased value of the house through the fact that it was wired. The tenant must also be impressed with the convenience, cleanliness, and comfort, and it would often be found that he would then wire the house rather than be without these. The difficulty was that the wiring became the landlord's fixtures, and perhaps a way out of that might be found by some method of wiring which would enable the tenant to remove it when he left.

When dealing with houses in this manner during spring cleaning, Mr. Young emphasised the need for putting in as many points as possible. The consumer could be told that a 16 c.p. lamp could be burned for 50 hours for one unit costing 7d.; and that a vacuum cleaner could be run for ten hours for one unit which probably only cost 1½d. according to the district. Many salesmen would probably surprise themselves if they made a list of the jobs that could be done for one penny.

In the discussion which followed, Mr. W. R. RAWLINGS appealed for co-operation, and said that supply companies, contractors, and manufacturers did not appear to be working in the same groove, perhaps unconsciously. Referring to the great difficulty a few years ago in getting a supply authority to connect up to a new consumer's premises, he said that he had even guaranteed a certain consumption because the company would not lay cables until such a guarantee was given, and the consumer would not do it. It was unfair for a contractor to have to give those guarantees when the supply authority was to reap all the benefit, and it showed that contractors were more progressive than those supplying energy. He appealed for assistance from the supply companies by supplying contractors with energy either free or at a very low rate for advertising purposes. He deprecated the E.D.A.'s sending out circular broadcast, because the overlapping which must take place was doing more harm than good.

Mr. ROBERTS said that architects were badly informed on electrical matters, and reminded his hearers that a joint meeting between the Institution of Electrical Engineers and the Royal Institute of British Architects had been arranged. Plugs were standardised, but the trouble was that they were never used. With regard to dining room devices, these were small current-consuming devices, and the current could be obtained through the dining room lighting fitting.

Mr. G. A. GILLOTT suggested that sales representatives, when dealing with new installations, should first make a complete specification, and bring the size of the installation down in stages if the client did not wish to spend so much money It was better than starting with a skeleton of a job and then adding to it.

Mr. H. MARRYAT said that the training of the voice was one of the prime assets of a salesman. With regard to the standard plug, the present demand was so small that the cost was prohibitive in competitive work. He recommended manufacturers to make larger quantities on speculation in order to bring down cost. As to the overlapping of circulars, Mr. Beauchamp might ensure that similar circulars were not sent to neighbouring contractors, if that had been done in the past.

Mr. A. GOWANS WHYTE (*Electrical Industries*) referred to the various kinds of plugs used in houses and advocated the use of plug extensions for various kinds of apparatus. As to architects, the architectural student should be borne in mind, and if something about electric lighting and cooking were included in his ordinary curriculum it would be a great advantage.

Mr. J. W. BEAUCHAMP said that if a circular were well illustrated and well written, the second, third or fourth that a man received would help, and he did not think it would do the harm which Mr. Rawlings had suggested. The sales of literature by the E.D.A. in 1922 represented 2½ times the money value of those sold in 1921. As to neighbouring contractors not using the same literature, he preferred to leave that to the contractors, because he was not inclined to refuse an order from one contractor because a neighbouring contractor had bought some of the same circulars. Dealing with plugs, he said the E.D.A. was out for standard dimensions, to ensure interchangeability. They did not necessarily ask the consumer to buy the standard plug, but the B.E.S.A. standard pin.

Mr. MANN asked that supply authorities should put mains in every street, and the contractors could then go ahead. It would be useful if Mr. Beauchamp could supply contractors with lists of gas consumers.

Mr. STANLEY (Westminster Electric Supply Corporation) defended the policy of supply companies, which were working under Acts of Parliament and had to abide by rigid rules. Anything which a consumer wanted in Westminster he would have. His undertaking was out to co-operate with contractors, and drew up specifications and put them up to contractors.

Mr. YOUNG, replying to the discussion, agreed that plugs were too expensive. He believed a good rotary switch and a 10-ampere plug with hand-shield top cost about 7s. 6d., which was too high, and he suggested that a little combination of the two could be made to reduce the cost. With regard to circulars, he disagreed with Mr. Rawlings that if a man had similar letters from two different contractors he would throw them away. He considered it would make him look again. As to co-operation, a very substantial number of supply authorities in the country now allowed contractors special rates. He also urged the importance of advertising in the daily Press. With regard to the joint meeting with architects, this was not half enough when they considered the thousands of architects there were in the country. Dealing with roads in which there were no mains, he believed the supply companies could be made to run the mains down a road if a contractor obtained sufficient business to ensure 20 per cent. return upon the supply company's capital expenditure in the first instance.

ELECTRICITY SUPPLY AT STOKE-ON-TRENT.

Modernisation of and Additions to Switchgear and Plant.

THE early generating plant and systems of distribution at Hanley, Longton, Stoke-on-Trent, and Burslem (which corporations commenced public supplies of electricity in 1894, 1900, 1904, and 1905, respectively) possess considerable historic interest, and when compared with those of recent date, they afford an excellent illustration of the process of evolution in this branch of engineering. Some of the old plant is usefully employed to meet the abnormal demands that are made for short periods during the winter.

At the Federation of the Potteries in 1910 the problem awaiting solution had a three-fold aspect: First, extensions of plant in each of the local works had been held back owing to the changes which were coming; secondly, the creation of the County Borough of Stoke-on-Trent made it possible for the first time to consider the district as a whole instead of dealing piece-meal with small areas; thirdly, there was the imperative call for economical generation and distribution. Indeed, many of the difficulties which are exercising the minds of engineers to-day in connection with the electricity districts delimited by the Electricity Commissioners have had to be met and overcome in the county borough. There is a similarity between the kinds of problems met with and the solutions arrived at, even if the magnitude was very much less.

The means adopted to overcome the difficulties were outlined in our issue of April 21st, 1922, when the principal extensions were described.

In the spring of 1920, however, it became evident that further additional plant would be needed. Accordingly two reciprocating sets, aggregating 300 kW, one at Burslem and the other at Stoke, were replaced by 1,250-kVA, 3-phase turbo-generators, thus utilising the existing steam-raising plant, the official inauguration ceremony taking place on January 18th this year.

The scheme, estimated to cost £60,000, was approved by the Electricity Commissioners in August, 1920, sanction to the loan being obtained in March, 1921, and includes conversion plant in each sub-works. The new plant is run on peak loads in parallel with the larger turbines in the main power house, and is thus doing on a smaller scale what the "county schemes" propose to do on a larger scale.

The two new sets, by the English Electric Co., Ltd., were designed for the following conditions:—

	Burslem.	Stoke.
Capacity at 0·8 power factor	1,000 kW	1,000 kW.
Overload	25% for two hours.	25% for two hours.
Type...	Impulse	Disk and drum.
Speed	3,000 r.p.m.	3,000 r.p.m.
Steam pressure at turbine stop valve	140 lb. per sq. in.	150 lb per sq. in.
Total temperature	420° F.	—
Superheat	—	50°F.
Vacuum at turbine exhaust	27·5 in. (bar. 30 in.)	27·5 in. (bar. 30 in.).
Voltage	3-phase, 51·5 cycles	6,600

The Burslem turbine has one compound velocity and six single impulse stages. It is provided with partial load governing, by which high efficiency is maintained at fractional load and overloads. The high-pressure steam belt is of cast steel, divided into three sections by auxiliary nozzle control valves directly actuated from the oil-relay cylinder of the governor gear, which for the first portion of the travel of the oil relay system affects only the supply of steam to the first section of nozzles, but any movement beyond this opens consecutively the full-load and overhead nozzles. A Michell thrust block and steam sealing glands of the carbon ring type are embodied in the design, and, in addition to the usual rotary gear-driven oil pump, an auxiliary reciprocating oil pump comes into operation automatically on the failure of the oil pressure. The alternator cooling air is drawn in by two fans on the rotor shaft through a Premier dry air filter.

For the Cole, Marchent & Morley condenser, d.c. motors drive the circulating and extraction pumps, and a steam air-ejector of the Delas type is fitted. Mr. W. M. Selvey tested this set after erection.

The Stoke turbine has one combined velocity and the requisite number of reaction stages. The main regulating governor is fitted with hand speed adjustment, being arranged to act upon a double-beat equilibrium valve in the steam-chest, and to control the speed within 6 per cent. momentary and 4 per cent. permanent variation between no load and full load, while the auxiliary or emergency governor, fitted with hand operation for emergency, comes into action with 10 per cent. excess over normal, when a second valve is released which shuts off steam by trip-gear. A rotary oil pump is run off an extension of the governor shaft, with a hand pump for emergency use. The C.M. & M. condenser cooling water, circulating and air extraction pumps are driven by d.c. motors, an auxiliary steam-air ejector being fitted. The alternator is wound for 2,800 volts, stepped up to 6,600 volts by an oil-cooled auto-transformer.

The extension to the conversion plant at the Burslem sub-works comprises a 1,000-kW, 750 r.p.m. rotary converter by the Metropolitan-Vickers Electrical Co., Ltd., 6,600 V, a.c., 550 V, d.c., which is started by a pony-motor operating on the M.-V. self-synchronising system.

In the Bagnall Street sub-works is a motor converter of the 500-r.p.m. La Cour type, by Messrs. Bruce Peebles & Co., Ltd., operating at 6,600 volts, a.c., and delivering 2,080 amperes continuously at from 460 to 480 volts or 1,000 kW, at from 480 to 550 volts, d.c.

While the larger consumers are being changed over to three-phase, the growth of the Hanley supply since 1913 has made it necessary to install a third frequency-changer, or motor alternator, this being the first addition made in the Hanley works since federation. It was made by the English Electric Co., Ltd. A combination bed plate, with three pedestal bearings (the centre one being water cooled) carries a 6,600-volt, three-phase, 51½-cycle, slip-ring induction motor (with the stator frame cast in one piece) coupled direct to a 2,000-volt, single-phase, 100-cycle, revolving-field alternator, giving 600 kW at 0.8 power-factor, and capable of 25 per cent. continuous overload, 50 per cent. for 10 minutes, and 100 per cent. momentarily.

The three-phase frequency of 51½ was chosen for the reason that synchronous motors have a slip at full load of about 3 per cent., otherwise the normal frequency would be 50. The synchronous speed of the motor is 618 r.p.m., so that at full load the set runs at 600 r.p.m. The rotor is in one piece, the core consisting of insulated laminated stampings, and the winding being of the barrel type. An overhung 65-volt exciter of 11 kW normal rating and 14½ kW for 10 minutes provides the field current for the alternator, which has a cast-iron stator frame, cooled by a current of air set up by the rotor, which escapes through ducts in the laminated core and holes in the outer shell of the frame. The core stampings have a layer of insulation on each and the slots are open, with grooves to receive wooden keys to hold the stator coils, which are insulated before being slipped into position, firmly in place.

A 100-cycle generator is somewhat unusual in these days. The alternator stator coils are wound on formers, with micanite tube insulation, through which the conductor of copper strand, covered with cotton braiding impregnated with insulating varnish, is drawn. Coil-ends are protected by sheet-steel shields secured to the frame. The alternator rotor consists of oval magnet poles attached to facings on the periphery of a cast-steel wheel with a double row of spokes and U-section rim. The field coils consist of copper strip wound on edge with adjacent turns insulated with paper; metal flanges at the ends of each coil secure it under pressure. The outside is turned up and polished.

The remotely-controlled switchgear at the sub-works is similar to that in the power house, and was constructed by the Metropolitan-Vickers Electrical Co., Ltd. Merz-Price protection is gradually being given to the older parts of the system, and "split conductor" protection has been adopted for several of the new e.h.p. feeders or trunk mains. At Burslem a set of moulded-stone cubicles, equipped with oil-break circuit breakers, have been built and duplicate bus-bars added, so as to obtain a flexible switching system. The existing cubicles were modified to line up with the new set. In the Stoke sub-works more drastic changes had to be made.

For the sub-station switchgear the draw-out truck pattern is standardised with hand-operated circuit breakers. The e.h.p. mains are three- or six-core, paper-insulated and lead-sheathed armoured cables laid solid in stoneware troughs. The mains of the three d.c. three-wire systems are principally insulated with vulcanised bitumen, laid on the solid system in stoneware troughs with porcelain bridges and tile covers by Callender's Cable & Construction Co., Ltd.

On the Hanley h.p. single-phase system there are about 70 static sub-stations, and on the e.h.p. three-phase system the sub-stations reduce the pressure from 6,600 to 415 volts per phase. The peak load on the whole system in December, 1922, was 6,740 kW, and the available plant capacity 8,000 kW.

In conclusion, we have to thank Mr. C. H. Yeaman, borough electrical engineer, for furnishing the information from which the above article was compiled.

"Saving Seconds."—The value of the accumulated time saved upon the "Underground" system is fully recognised by the companies, and every effort is made to "speed up" all operations. Considerable time economy is being effected by the use of ticket-issuing machines, and it is reported that on a recent occasion 1,174 tickets were issued by a "Roltic" machine; this included the giving of change to 492 passengers. The use of roll tickets also makes an actual financial saving, as they only cost half the price of the ordinary card tickets.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

"Redot" Electric Fires.

Messrs. J. & W. B. Smith, Ltd., 15-23, Farringdon Road, E.C.1, are responsible for a new type of electric fire element which, apart from its novelty, is very effective. This element, the "Redot" is illustrated in fig. 1. It consists, as will be seen, of two fireclay tubes of an open design in which are coils of closely-wound nichrome wire supported at the ends; these coils are about ¾ in. in diameter and have a consumption of 500 W each. The effect from a short distance away is to make the coils appear like glowing solid cylinders, and the fireclay tube causes effective distribution. At the back of the coils is a sheet of tin which protects the connections at the back and also acts as a reflector. The connections are of solid strip and their rigidity guards against the danger of short-circuits.

The element can be adapted to any design of fire. Fig. 2 depicts one of Messrs Smith's standard designs fitted with two of these elements (2 kW), and having a flat perforated top to permit a kettle or saucepan to be placed upon it for keeping liquids, &c., warm.

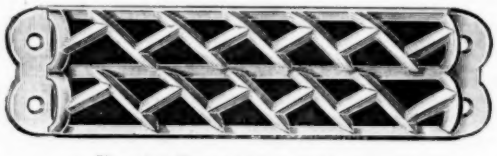


Fig. 1.—The "Redot" Element.

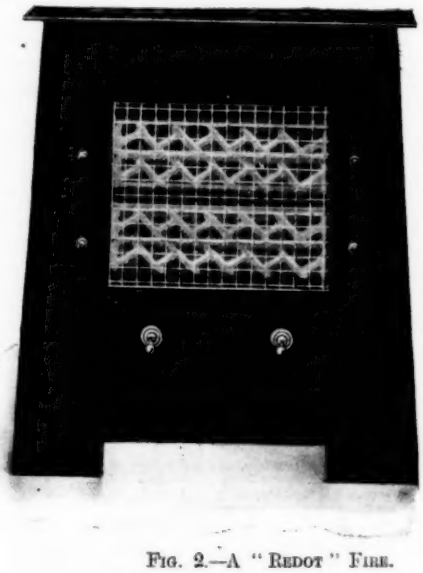


Fig. 2.—A "Redot" Fire.

A Coil-Insulating Device.

Mr. A. H. Hibbs, 13, Wesley Terrace, Rodley, Leeds, has sent us particulars of a machine for insulating and taping armature and stator coils (Pat. No. 178,174/21). This device is illustrated in fig. 5, and, as will be seen, consists of a frame with adjustable arms into which the coil to be treated is fixed. There is a free frame bearing a roll of insulating tape or cloth the width of the side of the coil. The mica or other insulation is shellaced all over on one side and, the end of the tape having been secured to the coil, the mica is placed between the coil and the tape and the two are wound round together by passing the frame up and over the coil. When the correct number of turns has been wrapped the tape is cut and the end is ironed over to give a smooth finish.

From samples of treated coils which we have examined, the device appears to perform its functions very well, making a neat and substantial job.

A Mechanical Time-Switching Device.

Fig. 4 illustrates a time-switching system which is being placed on the market by The Borough Engineering and Supplies Co., 31, High Street, Southampton. As will be seen, the device, known as the "Terry" control, consists of a chain fastened at one end to the switch lever, and at the other end to a strong spring. The clock, which is stated to be of a reputable make, actuates a release at the predetermined time, allowing the spring to retract and pull over the switch lever. The device is applicable to quite large switches—up to about 150-A capacity.

Fig. 3.—A Reflecting Electric Radiator.

Fig. 4.—The "Terry" Time Switching System.

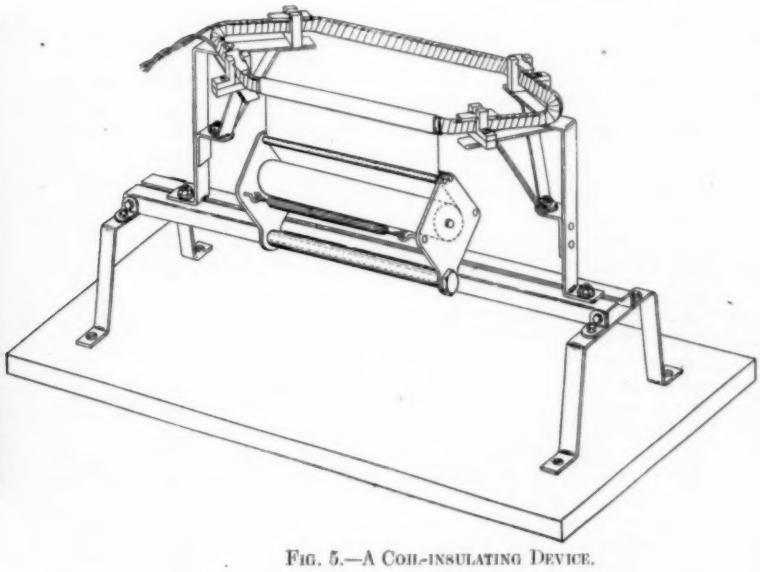


Fig. 5.—A Coil-insulating Device.

A Reflecting Electric Radiator.

Under the above heading the Canadian *Electrical News* recently described a new form of electric heater made by The Electric Heating & Manufacturing Co., of Seattle, U.S.A. This device, which is illustrated in fig. 3, is intended for operation from a lamp socket, although it has a 660-W element. The height is 10 in. and it is claimed that the heater throws its rays in all directions with no concentration in any one spot.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

597. "Telephone receivers." A. Orling. January 8th.
599. "Aerial wires for radio reception." C. V. Morris. January 8th.
600. "Storage batteries." E. Potter (Pernot, Kinsley & Cole). January 8th.
613. "Microphones, &c." F. P. di Cassibile and C. Hering. January 8th.
630. "Gears, rolls, &c." British Thomson-Houston Co., Ltd. (General Electric Co.). January 8th.
636. "Electric bell, &c., push switches." O. T. Banks. January 8th.
637. "Radio-frequency transmission systems." J. W. Buckley, A. P. M. Fleming, Metropolitan-Vickers Electrical Co., Ltd., S. J. Nightingale, and A. O. Rankine. January 8th.
639. "Electric converters, transformers, &c." R. M. Wilmotte. January 8th.
640. "Crystal detectors." H. E. Bunn and T. E. C. Wheeler. January 8th.
641. "Microphone transmitters for gramophones." P. E. Davenport. January 8th.
644. "Electric transmission at a distance." M. Isaacs and W. Smith. January 8th.
690. "Locking devices for electric incandescent lamps." T. Leah. January 9th.
702. "Devices for electric control of pianos, &c." F. Nunés. January 9th. (Germany, January 9th, 1922.)
710. "Electric push buttons." F. Matheson. January 9th.
712. "Electric furnaces." E. G. Danby. January 9th.
738. "Electric heater or vaporiser for internal-combustion engines." J. A. Mendenhall. January 9th.
766. "Vacuum tubes." F. Péri. January 9th. (France, November 7th, 1922.)
767. "Vacuum tubes." F. Péri. January 9th. (France, October 7th, 1922.)
768. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., C. Gillings, and W. O. Passmore. January 9th.
770. "Wireless telegraph receivers." F. G. Bell and Sterling Telephone and Electric Co., Ltd. January 9th.
776. "Wireless apparatus." J. B. Kramer. January 9th.
782. "Drives for paper-making machines, &c." British Thomson-Houston Co., Ltd. (General Electric Co.). January 9th.
783. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. January 9th.
795. "Electric head lamps, &c." P. G. P. McCulloch and W. E. Marshall. January 9th.
809. "Lamps for projecting a concentrated beam of light." W. Fenton. January 10th.
812. "Electric lamp reflectors or shades." O. J. Wootton. January 10th.
825. "Sparking plugs." G. B. Sykes. January 10th.
834. "Crystal holder for wireless receiving instruments." W. H. Murad. January 10th.
853. "Electric hand lamps." W. T. Coulson. January 10th.
857. "Electric motors." A. Green. January 10th.
865. "Apparatus for erecting telegraph poles, &c." E. Hole. January 10th.
880. "Electro-magnetic apparatus for recording sound." A. F. Sykes. January 10th.
884. "Fuses, and manufacture of same." F. Wasmayer. January 10th. (Austria, January 21st, 1922.)
885. "Insulating means for high-potential terminals, conductors, &c." P. H. Coursey. January 10th.
888. "Magneto-electric machines." M.-L. Magneto Syndicate, Ltd., and E. A. Watson. January 10th.
889. "Magneto-electric machines." M.-L. Magneto Syndicate, Ltd., and E. A. Watson. January 10th.
891. "Speed-controlling mechanism for paper-making, &c., machines." British Thomson-Houston Co., Ltd. (General Electric Co.). January 10th.
898. "Transformers for amplification." C. Lorenz Akt. Ges. January 10th. (Germany, February 11th, 1922.)
899. "Electric motors." W. H. Scott. January 10th.
915. "Cooling of dynamo-electric machinery." R. Velut. January 10th.
926. "Electric lamps." F. T. O'Hanlon. January 11th.
930. "Wheel for tramway, &c., vehicles." C. J. M. Mancor. January 11th.
938. "Amplifying apparatus for wireless telegraphy, &c." D. S. B. Shannon. January 11th.
939. "Grid-leak fittings for wireless telegraphy, &c." D. S. B. Shannon. January 11th.
940. "Receiving apparatus for wireless telegraphy, &c." D. S. B. Shannon. January 11th.
942. "Electric insulators." W. H. Eccles. January 11th.
961. "Holders for crystals of wave detectors for wireless receivers." R. W. R. Twelvetrees. January 11th.
977. "Burglar alarms." F. W. Austin. January 11th.
1,003. "Synchronous electric motors." L. H. A. Carr and Metropolitan-Vickers Electrical Co., Ltd. January 11th.
1,007. "Electrolysing fused salts of metals and recovering the metals and acid radicles." E. A. Ashcroft. January 11th.
1,009. "Microphones and telephones." F. P. di Cassibile and C. Hering. January 11th.
1,035. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). January 11th.
1,043. "Sparking plugs." W. Bryson (J. Maaten). January 11th.
1,051. "Commutator." A. R. Baker. January 12th.
1,075. "Controlling lifts, &c." A. C. H. Groom. January 12th.
1,082. "Ringing and signalling apparatus for telephone systems, &c." Coventry Automatic Telephones, Ltd., and C. C. Puckette. January 12th.
1,086. "Control of trains." A. R. Angus. January 12th.
1,090. "Dynamos." M. W. W. Mackie. January 12th.
1,111. "Magnetic contact-maker for electric circuits." A. Glazier. January 12th.
1,115. "Protective systems for electric cables." Callender's Cable and Construction Co., Ltd., and W. Lulofs. January 12th.
1,127. "Variable electric condensers." W. W. Drury. January 12th.
1,133. "Armoured electric cables." Callender's Cable and Construction Co., Ltd., and J. B. Gall. January 12th
1,136. "Arc lamps for kinematographic purposes." J. W. Hasselkus. January 12th.
1,145. "Amplifiers for wireless telephony, &c." G. S. Booth, S. C. Peacock, and G. B. Riley. January 12th.
1,153. "Crystal detectors." L. F. Barnes. January 12th.
1,178. "Marine signal lights." C. G. Rask. January 13th.
1,187. "Fuse devices for electric circuits." F. Sandler and E. Stein. January 13th.
1,217. "Electric plug and socket couplings." F. J. Plain. January 13th.
1,219. "Illuminated signs, &c." S. Fisher. January 13th.
1,220. "Electric batteries." British Thomson-Houston Co., Ltd., L. Griffiths, H. W. H. Warren, and A. P. Young. January 13th.
1,221. "Cathode ray apparatus." C. H. F. Müller (firm of). January 13th. (Germany, January 14th, 1922.)
1,231. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 13th. (United States, April 17th, 1922.)
1,232. "Radio receiving circuits." P. G. A. H. Voigt. January 13th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

17,234. "Electric signalling over submarine cables." B. Davies and Eastern Telegraph Co., Ltd. June 23rd, 1921. (190,736.)
17,258. "Electric motors for operation with high-frequency currents." Plauson's Forschungsinstitut Ges. June 23rd, 1920. (165,413.)
17,504. "Concentrated flaming arc lamps for projectors." Sperry Gyroscope Co. June 26th, 1920. (165,450.)
17,632. "Electro magnets." J. Neale and J. A. Manners-Smith. June 28th, 1921. (190,739.)
19,476. "Means for the production of electrical oscillations by means of choke coils or transformers with auxiliary magnetisation." Ges. Für Drähtlose Telegraphie. July 21st, 1920. (166,560.)
20,503. "Electrically-driven gramophones." O. P. Petersen and A. E. Wells. September 29th, 1921. (190,747.)
22,151. "Suspension of electric lamps." Neale Magnet Construction Co., Ltd., and J. Neale and L. H. Wilms. August 20th, 1921. (190,750.)
22,521. "Thermostatic controlling devices." British Thomson-Houston Co., Ltd. (General Electric Co.). August 24th, 1921. (190,755.)
22,825. "Variable-speed gear, more especially intended for electric photographic printing or copying machines." J. Halden & Co., Ltd., and J. H. Halden. August 29th, 1921. (190,758.)
22,860. "Electric apparatus for recording sound." A. F. Sykes. August 29th, 1921. (Cognate applications 31,027/21 and 17,661/22.) (Addition to 160,223.) (190,759.)
22,990. "Devices for balancing the currents in parallel-connected conductors for heavy alternating currents." A. B. Field and Metropolitan-Vickers Electrical Co., Ltd. August 30th, 1921. (190,761.)
22,999. "Rectifiers for high-potential alternating electric currents." A. C. Goolden, V. E. Pullin, and A. R. Greatbatch. August 30th, 1921. (190,762.)
23,157. "Devices for indicating and recording the duration of trunk-line telephone calls." Allmanna Telefonaktiebolaget L. M. Ericsson. May 20th, 1921. (185,429.)
23,434. "Electric batteries or accumulators." W. H. Exley, G. H. Handasyde, and L. C. Rawlence. September 2nd, 1921. (190,765.)
24,865. "Coupling for electric cables and for other similar or suitable purposes." H. E. Hadwen and H. Willis. September 20th, 1921. (190,769.)
25,076. "Thermionic valves." J. P. Prangnell. September 21st, 1921. (190,777.)
25,082. "Means for and method of obtaining an airtight joint around the leading-out wires and covers of casings for sealed electrical apparatus." G. F. Mansbridge. September 22nd, 1921. (190,778.)
25,249. "Starting arrangements for squirrel-cage induction motors." J. E. Evans-Jackson (T. Takeuchi). September 23rd, 1921. (190,783.)
25,479. "Electro-mechanical high-speed relay for wireless signalling." F. Wilson and H. S. Robertson. September 26th, 1921. (190,790.)
25,596. "Fluorescent screens." British Thomson-Houston Co., Ltd. (General Electric Co.). September 27th, 1921. (190,792.)
25,604. "Telephonic systems or apparatus, more especially intended for use in mines and the like." M. C. Ellison. September 27th, 1921. (190,793.)
25,611. "Röntgen-ray installations." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. July 4th, 1921. (182,750.)
25,700. "Apparatus for electric discharge through gases." General Electric Co., Ltd., and J. W. Ryde. September 28th, 1921. (190,798.)
25,800. "Electric reactors." British Thomson-Houston Co., Ltd., and H. S. Holbrooke. September 29th, 1921. (190,809.)
26,078. "Junction boxes for connecting electric conductors." G. H. Scholes and E. A. Claremont. October 3rd, 1921. (190,824.)
26,229. "Production of electrolytic iron." Soc. Le Fer. October 19th, 1920. (170,571.)
27,441. "Intervalve electric transformers or the like." A. F. Sykes. October 15th, 1921. (190,840.)
28,820. "Railway signalling apparatus." Automatic Telephone Manufacturing Co., Ltd., and A. E. Hudd. October 31st, 1921. (Addition to 166,703.) (190,851.)
29,885. "Electric circuit breakers." British Thomson-Houston Co., Ltd. (General Electric Co.). November 9th, 1921. (190,861.)
30,757. "Telephone systems." Siemens and Halske Akt. Ges. November 23rd, 1920. (172,092.)
32,162. "Sparking plugs." A. Bernollin. December 1st, 1921. (190,885.)
33,717. "Electric resistances." R. Amberton. December 15th, 1921. (190,902.)
34,240. "Thermally-operated circuit controllers." Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co.). December 20th, 1921. (190,906.)
34,308. "Electric equipment of motor vehicles of the Ford kind." F. Wood and H. E. Johnson. January 27th, 1922. (190,908.)
34,502. "Electric switch-boxes." A. L. Davis. December 22nd, 1921. (190,911.)

1922.

567. "Process for improving electrolytic mercuric oxide." Elektrizitatswerk Lonza. January 8th, 1921. (173,780.)
1,602. "Electrolytic cells." A. E. Knowles. January 12th, 1922. (190,924.)
2,963. "Electric transformers." English Electric Co., Ltd., J. W. Howard, and J. A. St. C. Richardson. February 1st, 1922. (190,934.)
4,171. "Electric contact devices working with a liquid, especially mercury." K. Kaisser. February 13th, 1922. (190,940.)
4,527. "Rheostat device for controlling electric lights for vehicles or for similar electrical purposes." T. B. Murray and Albion Motor Car Co., Ltd. February 16th, 1922. (190,942.)
6,465. "Radio antenna systems." Ges. Für Drähtlose Telegraphie. March 5th, 1921. (176,381.)
7,197. "Contact lugs for thermionic valves and electric couplings." F. W. Pellant. March 11th, 1922. (190,953.)
11,090. "Trolley harps for collecting electricity." M. P. Enyeart. April 20th, 1922. (190,967.)
13,915. "Electrolytic production of aluminium." M. Blasi. May 18th, 1921. (180,326.)
16,312. "Toy telephones." Gong Bell Manufacturing Co. June 11th, 1921. (181,396.)
22,591. "Electric gas purifiers." E. Oppen and Kirchhoff & Co. September 16th, 1921. (186,047.)
28,670. "Apparatus involving the use of a number of electrical cut-outs." W. H. Illingworth. September 26th, 1921. (Divided application on 189,284. (190,988.)

An Austrian Competition.—The Sewerbeforderungsamt Wien IX (9, Severingsgasse) Trade Promotion Office), announces a "general competition" for metal electric lighting fixtures, which are to be made by a Viennese firm. The object of the competition is the acquisition of artistic designs for electric dining-room lustres, saloon lustres, bedroom lights, bracket and standing lamps. The prizes offered are—first, 150,000 to 400,000 kronen; second, 80,000 to [illegible] kronen. Designs are to be sent in by February 1st.